THE DENTAL PRACTITIONER

AND DENTAL RECORD

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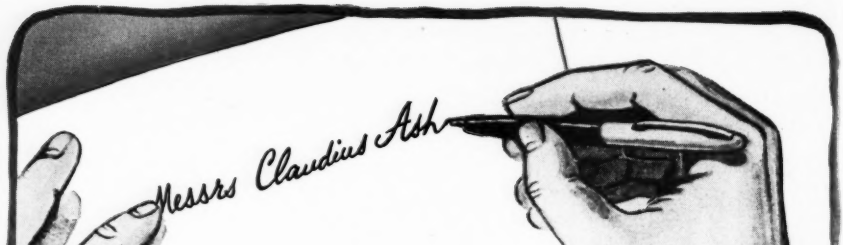

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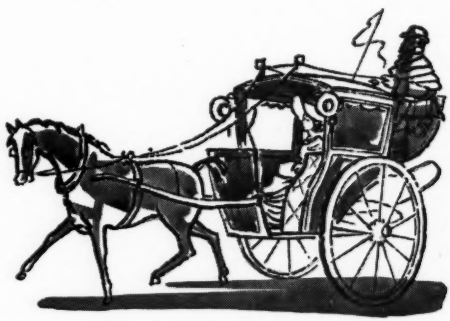

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Vol. X, *No.* 12 — *August*, 1960

CONTENTS

	PAGE
EDITORIAL: EXTENDING THE BOUNDARIES OF DENTAL RESEARCH	257
AN ORAL HYGIENE CAMPAIGN IN WELLINGBOROUGH — *D. H. Goose, B.Sc., B.D.S.*	258
A NEW APPROACH TO PORCELAIN INLAYS — *Eric K. Joseph, F.D.S. R.C.S.*	263
THE FREE-END SADDLE — *A. R. MacGregor, F.D.S. R.C.S. (Edin.)*	267
PAN-ORAL RADIOLOGY — *Sydney Blackman, M.R.C.S., L.R.C.P., D.M.R.E. (Camb.)*	270
BOOK REVIEW	274
ABSTRACTS FROM OTHER JOURNALS	154
LETTERS TO THE EDITOR	278
TRANSACTIONS OF THE BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS: SOME OF THE CAUSES AND EFFECTS OF MALOCCLUSION — *D. P. Walther, L.D.S., D.Orth. R.C.S., M.R.C.S., L.R.C.P.*	139

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THE DENTAL PRACTITIONER AND DENTAL RECORD

Vol. X, No. 12 August, 1960

EDITORIAL

EXTENDING THE BOUNDARIES OF DENTAL RESEARCH

In a recent report it was stated that almost two-thirds of the staff of the Medical Research Council were non-medical personnel. This, together with the fact that a new department of Medical Electronics has been opened by the M.R.C., emphasizes the point that modern medical research has become so complex as to require the services of experts from other fields of scientific endeavour.

No less can be expected in Dental Research. The rapid advances made in the last decade have led to an awareness that we in dentistry must also spread our net. Grappling with the problems of the ever-extending field of dental science, workers have found that mere dental knowledge is insufficient for the completion of their projects. Time and time again it has been necessary for them to go back and learn some highly specialized and complicated non-dental subject from first principles.

No longer can this situation continue if we are to achieve the best results from the time and money devoted to promoting inquiry into the more abstruse problems in our field. To obtain the best results in research it is imperative that the institutions where dental research is carried out appoint research staff from other scientific specialties. It is not enough to engage research assistants at low salaries; they must be well-qualified men who can look forward to a career in dental research. This not only applies to the basic sciences where some appointments have already been made, but to physicists, chemists, and electronic engineers. Elsewhere in the world it can be seen that research departments have forged ahead when these facts have been taken into consideration. Men such as Phillips, Brumfield, Harris, Fosdick, Schnieder, Rugosi, and Shaw have developed immeasurably the boundaries of our profession.

The time has come for radical thinking in the planning of dental research in this country so that the best value can be obtained from both the money and the brains available. With the new schools being built throughout the country the opportunity for this expansion in dental research personnel is now possible. Universities should be aware that the reputation of a university dental school largely depends on the value of the research projects undertaken by its staff. If dentistry is to progress and the high standard of the dental schools maintained, it is essential that the universities and associated research bodies budget for considerable expense on research facilities for non-dental staff as well as dental staff.

AN ORAL HYGIENE CAMPAIGN IN WELLINGBOROUGH

By **D. H. GOOSE**, B.Sc., B.D.S.

Lecturer in Preventive Dentistry, School of Dental Surgery, University of Liverpool

EVER since the McNair Report in 1956 had pointed to the "impressive shortage of dental surgeons" and the need for educating the public in the proper care of their teeth, there has been an increasing awareness of the need for more dental health education.

Consequently, it was decided to carry out some work of this type in the County of Northamptonshire, in order to see whether children's oral hygiene habits could be modified, and also whether there would be any reduction in dental disease as had been suggested by a former pilot study by Goose (1958 b).

MATERIAL AND METHOD

Owing to the limited time available to be spent on this work, and to financial considerations, it was decided to concentrate efforts on one town, Wellingborough, and to find a similar town near to act as a control, as, of course, children in the same town could not be used and remain uninfluenced by the propaganda put out to the experimental group.

Wellingborough is a clean, healthy, market town of 29,440 people whose staple industry is the manufacture of footwear. The control town chosen was Kettering, with a population of 37,430, which is situated eight miles away. This also is a market town with the same type of industry and a very similar social structure (census 1951). The birth- and death-rates of the two towns are closely comparable. The amount of fluoride in the water-supplies was between 0·3 and 0·4 parts per million in both towns. The ratio of dentists to population in Wellingborough was 1 to 2540, and in Kettering 1 to 2050, the school dental service being slightly better in the former town, making the availability of dental treatment quite similar for children. Altogether there were 5964 school children in Wellingborough, and as it was impracticable to examine them all it was decided to concentrate on the twelve-year-olds, because comparable figures for them exist elsewhere (*Health of the School Child*, 1952–3), and most deciduous teeth have been shed, thereby presenting a simpler clinical picture for analysis. *Table I* shows how alike were the basic dental conditions revealed at the initial survey. In this 274 boys and girls were inspected in each area, from the three secondary modern schools in Wellingborough and two in Kettering, but the figures in the table are based on those children remaining at the end of the campaign, i.e., 224 and 219 respectively.

The inspections were carried out in the schools with mouth-mirror, probes, and chip-syringe, using a head-lamp for constant illumination. A standard probe (Clinic No. 6) was used, being discarded after five examinations. All inspections (unheralded) took place in the morning before the eleven o'clock break, so as to assess the hygiene of the mouth without interference from mid-morning snacks, and, in addition, each child filled in a questionnaire on oral hygiene habits. Only children who had both good oral hygiene clinically and were either brushing three times or more a day, or once or twice a day but rinsing after meals when they could not brush, were counted as good.

For caries estimation the D.M.F. (decayed, missing, and filled teeth) index (permanent teeth only) was used, the usual criteria being observed (Appendix III, *The Fluoridation of Domestic Water Supplies in North America*).

Gingivitis was assessed by means of the P.M.A. (degree of inflammation of papillæ, margins, and attachments around the teeth) index in the anterior region only, and *Table I* shows the results of these observations.

THE CAMPAIGN

Immediately after the baseline statistics had been collected in June, 1958, an attempt was made to interest all the relevant and influential people in Wellingborough including the Medical Officer of Health, the Chief Education Officer,

the local School Dental Staff (two dental officers and two attendants), the nine health visitors, nurses and midwives, and twenty-two head teachers. Local doctors and dentists were invited to participate, and health educational material was given to them. The main points that were stressed were to encourage children to clean their teeth after all meals in one of three ways (brushing, rinsing, or eating detergent foods), and to avoid eating snacks between meals.

Several authors have found how quickly children lapse back into their former oral hygiene habits when instruction ceases (Davis, Parfitt, and James, 1956; McCauley, Davis, and Frazier, 1955) and so a continuous campaign was planned which lasted from September, 1958, until January, 1960, inclusive. At the start all schools received General Dental Council posters and a copy of their booklet *Dental Health*. During the first five months talks to small groups on the importance of oral hygiene in preventing decay, illustrated by coloured slides, models, etc., were given by the author at the three secondary modern schools in Wellingborough, and letters sent to the parents asking for their co-operation and assistance. After this, for the remainder of the campaign, three health visitors continued the talks in other schools.

In the spring of 1959, a competition was organized on a voluntary basis for all school children in Wellingborough, excluding the Grammar and High Schools. The Infants were given a poster to colour, the Juniors a rhyme to write on dental health, and the Seniors a dental poster to design and execute themselves. Some very good work was presented and four prizes awarded, two in the Senior section. One poster was so good that it was copied and made available for use later in the schools during the campaign (*Fig.* 1).

In the summer, a two-day exhibition was staged at the local clinic, and many exhibits shown, including the General Dental Council's stereoscopic viewer and showcases of development and decay, Oral Hygiene Service films, Ministry of Health posters, the best entries from the competitions, and a clinical demonstration of the cleansing effect of apples on the teeth. In addition a surgery was laid out suitably, and the dental attendant on duty gave details of various types of treatment available, and handed out a wide variety of

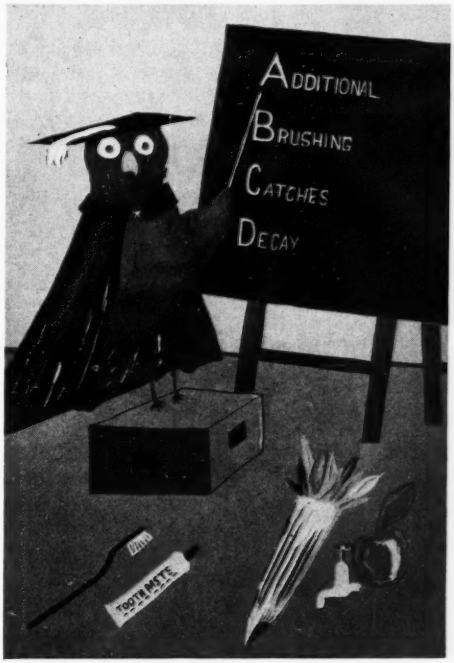

Fig. 1.—One of the posters produced for the exhibition by a schoolboy.

leaflets on dental health. About 400 school children attended in parties from all schools except the Infants and the Grammar and High Schools. The general public were also admitted, the exhibition having been publicized locally in the Press, at Council Meetings, and on the B.B.C.

At the beginning of the winter term more Health Educational Material was sent to local doctors and dentists, and the Local Authority Staff were again briefed and supplied with additional material, i.e., posters and pamphlets from the Ministry of Health, Central Council of Health Education, and the Oral Hygiene Service. Questionnaires on oral hygiene habits were sent for Senior children

to complete, further posters for Infants to colour, and Juniors were asked to write an essay on dental health. In addition, a dental article appeared during December in the local paper, written by the author. During the whole period of the campaign those children who actually attended the Dental Clinic in Wellingborough for treatment received individual instruction in oral hygiene as well as suitable pamphlets.

Table I.—Dental Condition of Twelve-year-olds Before and After a Seventeen-month Campaign of Oral Hygiene in Wellingborough

Schools*	Good Oral Hygiene (per cent)			Mean D.M.F.			Mean P.M.A.		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Wellingborough Male 106; Female 118									
Before	0·94	2·54	1·78	4·90	5·69	5·32	11·54	10·08	10·78
After	7·54	19·50	13·83	7·53	8·96	8·29	13·29	10·94	12·07
Kettering Male 108; Female 111									
Before	1·85	6·31	4·11	4·61	5·94	5·27	12·71	12·90	12·81
After	0·00	4·50	2·28	7·60	8·48	8·03	13·62	12·06	12·83

* Figures from the separate schools summed in each area.

Table II.—Changes in Dental Condition during the Period of the Campaign

Schools	Good Oral Hygiene (per cent)			Mean D.M.F.			Mean P.M.A.		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Wellingborough Male 106; Female 118 *Test*	6·60	16·94	12·06	2·63	3·27	2·97	1·75	0·86	1·29
Kettering Male 108; Female 111 *Control*	−1·85*	−1·81*	−1·83*	2·99	2·54	2·76	0·91	−0·84†	0·02

* Negative value means a deterioration of some children who formerly had good oral hygiene.
† Negative value means a decrease of P.M.A., i.e., an improvement of gum condition.

RESULTS

A re-inspection of all the children still available was carried out in January, 1960, rather earlier than had been planned owing to unavoidable circumstances, and *Tables I* and *II* record the effect of the campaign. It may be seen that there was a moderate improvement in oral hygiene habits in Wellingborough as a result of the campaign, whereas in Kettering they actually got worse.

The number of D.M.F. teeth per child affected during the period of the campaign was slightly less in boys in Wellingborough (2·63) compared with those in the control town of Kettering (2·99); however, with the girls the position was reversed, being 3·27 and 2·54 respectively. Similarly, the P.M.A. figures show a slightly worse picture in Wellingborough than in Kettering, this time both for boys and girls.

A comparison is made in *Table III* between those children in Wellingborough who were carrying out correct oral hygiene (8 boys and 23 girls) and the Kettering children. Here, the boys in Wellingborough show less caries (2·62) than in the control group (2·99), and the girls again show more, 3·26 compared with

2·54 in Kettering. However, now the P.M.A. has decreased in Wellingborough children (2·37 for boys and 1·17 for girls) compared with an increase of 0·91 for boys and a decrease of 0·84 for girls in Kettering.

Table III.—Comparison of Children with Good Oral Hygiene Habits and the Controls

	Mean D.M.F.		Mean P.M.A.	
	Boys	Girls	Boys	Girls
Test Male 8 Female 23	2·62	3·26	—2·37*	—1·17
Control Male 108 Female 111	2·99	2·54	0·91	—0·84

* Negative values indicate a decrease in P.M.A. during the period of the campaign.

DISCUSSION

It is evident that the campaign has not been successful in influencing many children to change their oral hygiene habits, and Parfit, James, and Davis (1958) found similar difficulties in their St. Albans study. In fact, only about 14 per cent of the Test children improved to the somewhat rigorous standards set, girls being better (18·6 per cent) than boys (8·5 per cent). These results represent the overall improvement in Wellingborough children bearing in mind that the Kettering ones became worse, and all results were significant at the 0·01 level of probability. Rowntree (1959), among others, has also noted that girls show a better standard of oral hygiene than boys, and in the present study it was revealed by the questionnaires that girls' motivation was probably appearance, as 31·8 per cent gave this as their main reason for the care of teeth; in the case of boys only 11·3 per cent gave this reason.

That the children had learnt the facts about oral hygiene was revealed by the final questionnaires; for example, 50 per cent of boys and 50·7 per cent of girls who completed this knew two alternative methods of cleaning, besides brushing, whereas in the control group the numbers were respectively 18 per cent and 23·5 per cent. It is obvious, here, that it is one thing to present children with the knowledge of oral hygiene, and another thing to make them carry it out, and this is really the parents' duty. However, where the "extraction and denture" mentality still exists among parents it is difficult to see how it is possible to make their children value their teeth. Perhaps health education only makes its effect on the next generation when children become parents.

With only 31 children changing their habits for the better it is unlikely that any significant change in either D.M.F. or P.M.A. would be seen in the whole group, and *Tables I* and *II* reveal this. If these 31 children with good oral hygiene habits are compared with the Control group (*Table III*) one would expect to see an improvement, but all the results are statistically insignificant at the 0·01 level, but of course the small numbers involved here necessitate caution in interpretation of these comparisons.

However, it is perfectly clear that with the limited resources and manpower available for dental health education at present, any noticeable improvement in children's dental health is rather unlikely. Obviously a much more widespread and comprehensive approach is needed, with a high-powered barrage of propaganda through the medium of radio, television, and the Press on one hand, and on the other a continuous and all-embracing regional effort, probably centred on the Local Authority Health Department.

The commercial opposition to avoidance of between-meal snacks will be considerable, and the concentrated propaganda put out by the sweet and biscuit manufacturers is already formidable. One particularly unfortunate form which was encountered was the selling of biscuits to head teachers for their school tuckshops at wholesale prices, since they were able to take the profit from their re-sale to use for the school funds. This provides the teachers with a vested interest in tuckshops, and it was found impossible to get any of them closed. Presumably the best approach to this problem will be to find suitable alternatives such as fruit and possibly nuts, which could be sold instead.

Dental health education material in this country is still rather limited in variety, and this proved a handicap even although additional material was prepared locally (*Figs.* 1 and 2). There is need for more varied pamphlets suitable for different age-groups, such as those

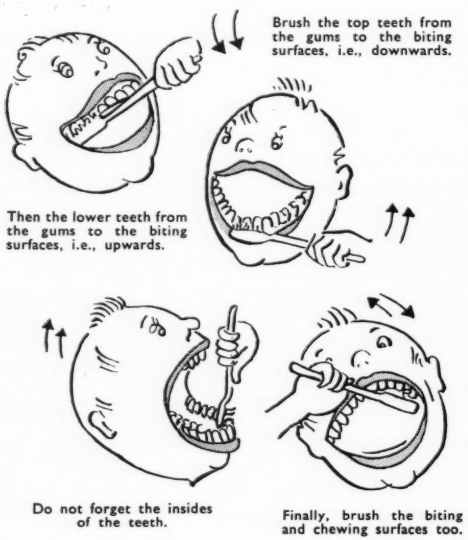
Brush the top teeth from the gums to the biting surfaces, i.e., downwards.
Then the lower teeth from the gums to the biting surfaces, i.e., upwards.
Do not forget the insides of the teeth.
Finally, brush the biting and chewing surfaces too.

Fig. 2.—Part of a pamphlet produced by the author suitable for young children.

prepared in Germany and Switzerland (Goose, 1958 a), and things like book marks which can be handed out at libraries.

Experience showed that it is a great help to make children participate in dental health education by means of colouring posters, writing essays, and having group discussions, etc., but one difficulty arose in this connexion: as dentists we are rather obsessed with the necessity of dental health, and it is important to remember that lay-people have other interests, and if we press our viewpoint too much we may antagonize them. For example, one of the most co-operative of the head teachers became rather tired of the campaign after a time, and consequently was not very willing to allow the final assessment to be carried out in his school. In fact, dental health education must be integrated into health education in general, and both must be found a place of primary importance in the education of children to-day if they are to be able to live full and healthy lives.

SUMMARY

1. An oral hygiene campaign was carried out over a period of seventeen months on children in Wellingborough, and the results assessed by comparing 224 twelve-year-old children there with 219 control children in Kettering.

2. An overall improvement in oral hygiene habits was observed of about 14 per cent (boys 8·5 per cent and girls 18·6 per cent), all results being significant at the 0·01 per cent level.

3. There was no improvement in D.M.F. or P.M.A. for either the test children as a whole or even for the group who were actually carrying out ideal oral hygiene habits.

4. Thus it was found that in spite of a considerable increase in knowledge of oral hygiene the test children on the whole were not much influenced to change their habits, and it was suggested, therefore, that a much stronger, more expensive, and nation-wide campaign must be instituted to have any substantial effect in reducing dental disease in children.

5. Some of the difficulties of a local campaign have been described, and various suggestions made for overcoming them.

Acknowledgement.—I would like to record my thanks to Dr. C. M. Smith, O.B.E., Medical Officer of Health for the County of Northamptonshire, for his help and encouragement.

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A NEW APPROACH TO PORCELAIN INLAYS

By **ERIC K. JOSEPH**, F.D.S. R.C.S.
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WHILST dentistry is making rapid progress in many fields the problem of making æsthetic and really permanent restorations in anterior teeth remains unsolved. Translucent cements give poor results unless prepared under the most rigid conditions, whilst self-curing acrylic resins have proved a disappointment (Morrant, Kramer, and Pickard, 1956; Coy, 1958). Fused porcelain alone satisfies the requirements of the anterior restoration, but the technique for its use in general practice has hitherto been impracticable and uneconomical. The method to be described below makes use of recent advances in conservative dentistry, so that one of the oldest and most permanent of dental materials can be used with the minimum of chairside time, and a simple laboratory procedure.

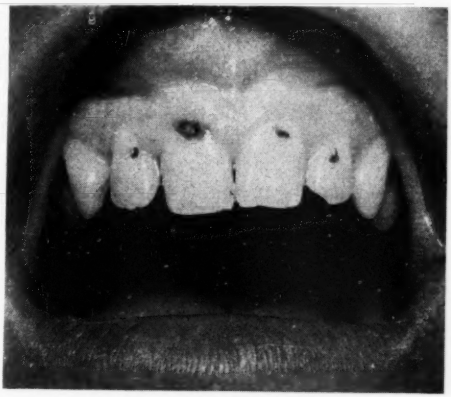

Fig. 1.—Labial cavities in $\frac{21|12}{}$.

Fig. 2.—Cavities restored with porcelain inlays.

Fused porcelain was developed by Chinese ceramists during the T'ang dynasty (A.D. 618–907), when China was said to be the greatest and most civilized power in the world. Chinese potters, who had hitherto been producing work of a high quality, excelled themselves during this period, and were famous not only for their beautifully shaped articles but also for their coloured glazes. It was their attempt to produce harder felspathic glazes at higher temperatures that produced the first porcelain. The technique found its way to Europe during the 14th and 15th centuries, where it caused great excitement because of its whiteness and translucency. Porcelain was copied in Florence in 1575, and rapidly became used all over Europe. It was found possible to reproduce the colour and translucency of teeth in this hard durable material, and the first porcelain teeth were manufactured in 1815. The porcelain jacket crown was introduced in 1885 (Land, 1886) and porcelain inlays were in use by 1889.

The increasing demand for dentistry at the beginning of this century, coupled with the introduction of the more easily prepared translucent cements, in 1904 led to the eclipse of fused porcelain with its tedious and exacting technique. Furthermore, the translucent cement restoration appeared at first more natural than the porcelain inlay with its often obvious cement edge. Porcelain has stood the test of time, however, and might enjoy increasing popularity with a simpler technique available. The author has evolved such a technique for restoring multiple cervical

cavities and it is being extended to other situations where porcelain can be used (*Figs.* 1 and 2). The impression of these cavities is taken with silicone rubber material in a prepared tray, and a model is cast in refractory

Fig. 3.—Impression and corresponding model.

investment. The porcelain inlays are baked directly in this model.

CAVITY PREPARATION AND IMPRESSION TECHNIQUE

Porcelain inlay cavities resemble gold inlay cavities in having parallel or slightly tapering walls, but because of the relatively low tensile strength and edge strength of porcelain they should provide for sufficient bulk of material to resist fracture and should have no marginal bevel. As many as six cervical cavities may be prepared at one time. If they extend beneath the gingival margin it is advisable to expose that region by careful use of the electric cautery. It is essential for the cavities to be clearly and completely defined in the impression. The individual cavities may be identified by modifying their shape (Von Ilg, 1955) or by fitting the baked inlays to a duplicate model. The impression tray is simply made by doubling a strip of expanded metal and contouring it to the desired shape. This shape is then held rigid by applying a coat of quick-curing acrylic resin to the outer layer of metal, care being taken to avoid obliterating the perforations of the inner layer which is to hold the impression material. A little practice with these materials will soon result in the manipulation of such trays for any situation within a few minutes. The cavities are carefully dried so that the impression material will adhere to them. They are filled individually with a syringe, care being taken to avoid trapping air. The remainder of the material in the syringe is used to overlay the whole area. The tray, which has been loaded in the meanwhile, is placed in position and held there until the material has set.

LABORATORY TECHNIQUE

A technician of average dexterity should soon learn to bake inlays which require only the minimal finishing in the mouth. Magnifying glasses and really adequate lighting will greatly improve the results which can be obtained. The impression may need to be boxed in with a strip of wax and is then cast in one of the special refractory investments which are now marketed for porcelain work. Some silicone rubber impression materials emit hydrogen, which causes pitting of the surface of the model, and should not be cast for twenty-four hours. They may, however, undergo distortion during this period (Östlund, 1957; McLean, 1958). The author has found improved results when using similar products which can be cast immediately.

The thickest mix of investment powder and distilled water which can be vibrated into the mould should be used, thus ensuring a model, the edges of which will be strong enough to withstand removal of the impression. This "putty-like" mix can be encouraged to flow by directing it with a fine-pointed camel-hair brush. When the model has been allowed to set for at least thirty minutes the impression is carefully removed from the model so that neither is damaged (*Fig.* 3). If the model is in any way imperfect a new one may be cast. A stone or copper plated model may finally be made from the original impression. This is useful for finishing the inlays upon and for presenting them at the chairside.

The inlays are then baked in low-fusing porcelain (980° C.) in a small furnace which

does not need a pyrometer. The stages can be controlled by direct vision if the furnace door is opened from time to time and the contents are illuminated with an electric lamp (Dennison, 1958). In order to control shrinkage the inlays are baked in three stages. The model is first soaked in distilled water and a wet mix of porcelain powder is carried over the floor of the cavities and dried out. This is then baked to the "biscuit" stage, when it will be seen that the porcelain has fused into a solid mass with a mat surface. After the model has been allowed to cool it is again soaked, and porcelain is built up to the margins of the cavities before slowly replacing it in the furnace and again baking to the biscuit stage. The third bake is carried out when the cavities have been slightly overfilled in order to provide contour to the inlays, and they are baked until they present a glazed surface. Manufacturers' suggestions for colour matching are a useful guide and the operator will soon learn which blends to use.

Fig. 4.—Class IV inlay cavity with pin in position.

Fig. 5.—Class IV cavity restored.

Cementing and Finishing.—The inlay can be handled by attaching it to a probe by means of a bead of sticky wax. It can be positioned on the probe whilst the wax is still soft if this should be necessary and tried into the cavity for any adjustments to be made to the edges. The floor and walls of the cavity and the fitting surface of the inlay are then painted with a thin mix of cement and the inlay is replaced and pressed firmly home with a wooden stick. Inlays prepared by this method fit so accurately that if the cement is mixed too thickly, or too much is inserted into the cavity, difficulty will be encountered in pressing the inlay into position.

In order to avoid the unsightly appearance of oxyphosphate cement, various translucent cements have been used. These pick up the colour of the surrounding tooth structure, impart translucency, and provide a cement edge which is virtually invisible. One of these (Terralux) has given most pleasing results, but in view of its doubtful value as a filling material great care should be taken when it is used. Once the inlay is in position the excess cement should be removed before it has set and the edges should be covered with the makers' special grease. When the cement has hardened the whole area should be protected with a coat of varnish and no attempt should be made to finish any further until the next visit. The edges should then require only the slightest disking and polishing. Other cements are also being tried and it remains to be seen which will prove to be the most satisfactory over many years.

OTHER INDICATIONS FOR USE

Class I and Class II Cavities.—Porcelain may be used for restoring these cavities in premolars where amalgam or gold restorations would show during normal conversation. To check the bite in Class I cavities the investment model is carefully occluded with a model of the opposing teeth. With Class II cavities a similar overall impression is taken,

but in order to provide access to the interproximal aspects of the preparation the adjacent tooth is blocked out with wax before the investment model is cast. Alternatively, the contact point of the inlay and final adjustments can be dealt with by fitting the inlay to a duplicate model.

Class IV Cavities.—Porcelain inlays with platinum pins can be produced by the same technique (*Figs.* 4 and 5). If the pins do not fit too tightly their free ends need only be slightly roughened to ensure that they withdraw with the impression. They become embedded in the model when it sets and remain there when the impression is removed. Difficulties have been encountered with these inlays, due partly to uncontrolled shrinkage of the porcelain and partly to unwanted edges on the inlays which have prevented them from seating correctly. Shrinkage can, however, be overcome by adopting a similar procedure to that used for producing porcelain crowns. The inlay is first overbuilt in powder and allowed to shrink. The crevices which result thereby are filled by vibrating wet porcelain into them and rebaking.

Class III Cavities.—The technique does not lend itself well for use with these cavities because removal of the impression will often damage the model. A direct wax pattern may be invested, however, and the inlay can be baked in a similar manner (George, 1956).

Porcelain Pontics and Facings.—This technique enables fractured porcelain facings to be replaced without removing the bridge or crown from the mouth.

CONCLUSION

Fused porcelain is enjoying a revival in conservative dentistry, not only because of the exciting techniques of vacuum firing and bonding directly to gold which have recently been developed, but because it has also been made easier for good results to be obtained with simple equipment. Small yet efficient furnaces are now available at prices which are reasonable enough to encourage their use in general practice, and finer porcelain powders have been developed which can be more easily handled. It is hoped to persuade manufacturers to colour low-fusing porcelain powders and to produce even harder investments, so that the margins of porcelain inlays can be built with very great accuracy. There is no reason why porcelain inlays should not share in this revival.

Materials and Equipment.—

Cements.—TERRALUX-UNIVERSAL, E. Mühlbauer & Co., Hamburg-Bahrenfeld, Germany; PETRALIT, Dental Fillings Ltd., London, Gt Britain.

Investment.—NEO-BRILLAT, Dentalchemie C. C. Schrepfer, München, Germany.

Porcelain.—VITA-LUMIN PORCELAIN, 980°C., Vita-Zahnfabrik, Säckingen, Germany.

Furnace.—ROST, R. B. 1150A, Oskar Rost, Berlin-Schöneberg, Germany.

Acknowledgements.—The author wishes to thank Professor E. Bradford for his help in preparing the manuscript. Thanks are also extended to Mr. A. I. Robinson, senior technician, University of Bristol Dental School, for reviving his interest in porcelain, and to Mr. A. English, whose technical skill and enthusiasm have helped in developing this technique.

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Part II of "Congenital Malformations of the Mouth and Jaws", by R. T. Routledge, will appear in the September issue of this JOURNAL (*Vol.* XI, *No.* 1). Part I was published in *Vol.* X, *No.* 11, p. 236.

THE FREE-END SADDLE*

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IT is probably true to say that more has been written in prosthetic literature about the free-end saddle, and particularly about the lower free-end, than any other type of partial denture (Osborne and others, 1957). The reason for this is not certain, but it is probably because of the complexity, and difficulty of meeting the basic problem, of this type of denture. This basic problem is simply one of support, which can be defined as the tissues of the mouth which support, or act as a foundation for, the load of mastication during the various occlusal excursions of the mandible. This support problem can best be discussed under two headings:—

First, the support tissues themselves are of two distinct types. There are the remaining teeth and periodontal tissues, and, for all practical purposes, we must consider them rigid and immovable unless subjected to abnormal forces. There are also the tissues of the saddle area, consisting of bone covered by mucosa of varying thickness and of varying compressibility. The average compressibility, measured under a load of 100 g. per sq. mm., is shown in *Fig.* 1. Because of this, any part of the denture overlying the saddle area must move when subjected to load (Steiger, 1952).

Secondly, a deficiency of true support-tissue arises after the loss of posterior teeth. The area of periodontal membrane of a first lower molar is about 400 sq. mm., while the area of mucosa left is only about 100 sq. mm. (Watt, MacGregor, Geddes, Cockburn, and Boyd, 1958). The combined area of periodontium of the three lower molars, for example, is about 1200 sq. mm., while the area of mucosa remaining after extraction is only about 330 sq. mm., i.e., about three-quarters of the tissue is lost. In the upper jaw the deficit is just as severe. Thus there is a *physical* deficit of support. Also, the remaining mucosa is a tissue not fitted to carry loads, but is merely a covering tissue. Thus there is also a *biological* deficit of support in all free-end saddle areas.

Therefore the problem of the free-end saddle is seen in two ways:—

1. The difference in the two kinds of support tissue, viz., the remaining teeth and the mucosa of the saddle areas.

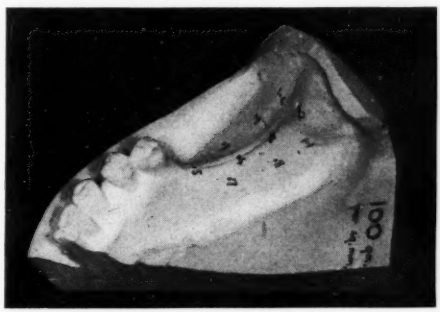

Fig. 1.—Average compressibility of the lower free-end saddle area, measured under a load of 100 g. per sq. mm.

2. The support tissue deficit which is both physical and biological.

These factors apply in both upper and lower jaws, but are less important in the upper where the deficit is not so great because the palatal tissue can be used for support. Also, the amount of mucosal compressibility in the upper jaw is invariably less than in the lower and consequently the denture foundation is not so difficult to control.

In attempting to solve the difficulty of treatment for the free-end saddle there are two fundamentally different types of denture bases which can be used:—

1. Entirely tissue-borne denture (*Fig.* 2 A) in which all the load is carried by the mucosa and bone of the edentulous saddle areas. The remaining natural teeth carry none of the load applied to the denture, but are utilized only to help retention. These dentures are simple in design and construction.

* Paper read to the Odonto-chirurgical Society of Scotland on January 8, 1959.

2. The tooth- and tissue-borne denture (*Fig.* 2 B) in which all or some of the remaining teeth are utilized to support, by means of incisal or occlusal rests, part of the load which is applied to the denture. This type of denture incorporates the use of flexible connectors or stress-breakers and it is, therefore, more difficult to design and construct. The simplest type of stress-breaker is round-section cast alloy, the resiliency of which can be varied for any particular case.

A B

Fig. 2.—A, Tissue-borne denture. The saddles are connected by a rigid lingual bar and the clasps merely aid retention. B, Tooth- and tissue-borne denture. The connexion between tissue-borne saddles and tooth-borne continuous clasp is by flexible stress breakers. One-piece chrome-cobalt casting.

LOAD: 8 kg.

SMALL SADDLE : 250 sq. mm.
AREA OF WIPE OFF: 240 sq. mm.
i.e., 1 sq. mm. mucosa accepts 33 g.

LARGE SADDLE : 410 sq. mm.
AREA OF WIPE OFF: 361 sq. mm.
i.e., 1 sq. mm. mucosa accepts 22 g.

Fig. 3.—Experiment to demonstrate load per unit area. The area of wipe-off is the area of mucosa accepting primary load.

Whatever the type of denture base being used there are two important rules which must be obeyed with regard to the saddle itself. These rules are well known, but are not always carried out. These are: full coverage of the saddle area by the denture saddle, and reduction of the occlusal table of the posterior artificial teeth being used. When it is remembered that about three-quarters of the support tissue is lost in the saddle area, and that the mucosa is not suitable for support, anything that can be done to reduce the load per unit area is of benefit to the patient. A simple experiment demonstrates this (*Fig.* 3). Two clear acrylic saddles, of different sizes, were made for a patient. Each saddle in turn was painted with thin impression paste, inserted in position, and the patient closed with a load of 8 kg., measured by means of a bite-gauge. When the paste had set, and the saddles were removed, part of the area was found

to be clear of paste. This area, which was clear of paste (the area of wipe-off), was assumed to be the area of mucosa accepting primary load and it is seen that under the larger saddle the mucosa is subjected to a much reduced load per sq. mm. *Fig.* 4 shows the practical application of this where one saddle is underextended and covers only 230 sq. mm., while the other saddle is correctly extended—laterally on to the buccal shelf and posteriorly on to the retromolar pad—and this covers 400 sq. mm. The length of the circumference of the saddle may also influence its support (Körber, 1954). The narrow posterior teeth allow easier penetration of food during mastication and thus help to reduce load on the saddle area.

As already stated, there are two different types of denture design which can be used for the free-end saddle—the entirely tissue-borne, which can be termed the simple design, and the tooth- and tissue-borne, which is invariably more complex. In an endeavour to compare various different types of denture design some experimental work was done with biting loads (MacGregor, 1958). The conclusions of this experiment were limited, but were as follows: (1) The simple, entirely tissue-borne denture accepts the least amount of load and has limited function in this respect. (2) The more complex tooth- and tissue-borne dentures accept more load, but change of design in this group does not affect the load at the posterior end of the saddle. The more rigid the connexion between tissue-borne and tooth-borne parts, the more the load is increased.

It is important to remember, however, that because a denture accepts more load, within the bounds of patient tolerance, it does not follow that it is a better design. Indeed, the converse may be the case because of the biological deficit of support already mentioned, and excessive loads may cause tissue damage.

In order to spread the load as widely as possible the design of choice in the average case is one where the tooth and tissue-borne parts of the denture are joined with flexible connectors, and the more compressible the mucosa the more flexible should the connectors be. Flexibility can be adjusted by the length, cross-section, and material of the connector. This is to minimize the levering and torsional force which would be applied to the remaining teeth when load is applied to the tissue-borne saddle.

When deciding which type of denture to use in any particular patient, the answer is

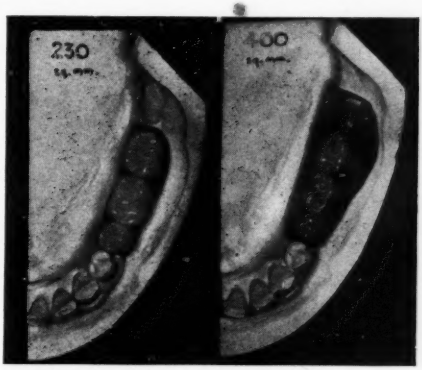

Fig. 4.—Showing how the support area is almost doubled by correct extension of the free-end saddle. Narrow posterior teeth allow correct shaping of the saddle and easier penetration of food.

not at all easy, but free-end saddles can be broadly grouped into two types:—

1. The well-formed edentulous ridge is found usually where the teeth have been recently extracted. Because of the lack of atrophy of alveolar bone there is also a stable, thick mucosa which is of fairly even density and compressibility. These cases have good support and consequently do very well with a simple tissue-borne denture (*Fig.* 2 A). The saddles may be connected by a lingual or labial bar of wrought stainless steel.

2. In the second type of free-end saddle the alveolar bone and covering mucosa are atrophic. There is a considerable reduction in support territory due to the atrophy, and wide buccal extension of the saddle is difficult if not impossible. The mucosa is thin and is not compressible. The support in these cases is poor and the prognosis is not favourable with the simple tissue-borne denture. It is in these cases that tooth support must be utilized in order to spread the load, and this can be done by a tooth-borne cast continuous clasp (*Fig.*

2 B). The connectors between the saddles and cast clasp are flexible. The amount of movement between saddles and tooth-borne clasp is minimal because of the incompressible mucosa and, therefore, the levering and torsional forces on the natural teeth are small. In extreme cases the mucosa over the crest of the ridge is so thin that pressure by a hard acrylic base causes discomfort, and these cases can be satisfactorily controlled by lining the saddle in the affected area with either guttapercha or a soft silicone rubber.

In all free-end saddle areas there is always considerable tissue change taking place after the denture has been worn for some time. In the early stages there is a re-shaping or redistribution of mucosa and later there is alveolar bone loss. These changes cause loss of fit between saddle and mucosa and sinkage of the saddle below the level of the occlusion. The support of masticatory load is not affected as long as food lies between the upper and lower teeth, but when the patient clenches and the teeth meet, the mucosa under the saddle is not compressed and therefore does not contribute to the support of the denture. This can be remedied by rebasing the saddles (Wilson, 1955), but it is not easy to say when this rebasing should be done or how long it will last before the denture once again sinks below the occlusion.

The changes which take place in the supporting tissues after a free-end saddle denture has been fitted require further and more detailed investigation.

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PAN-ORAL RADIOLOGY*

THE MOST RECENT ADVANCE IN DENTAL RADIOGRAPHY

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FROM the very first days after Professor Röntgen, in 1895, discovered the X-rays, their subsequent utilization in the fields of medicine and dentistry was increased by the concerted efforts of physicists, technicians, mechanical engineers, and radiologists, as well as the medical and dental professions themselves.

As new and more stable apparatus was manufactured and acquired by hospitals and medical men, so new procedures and techniques were advocated in the X-ray examination of the patient. Advance in dental radiography, however, has lagged behind, because the horseshoe configuration of the face and jaws demanded, at the very outset, much compromise with the basic principles of radiographic methods.

The bugbears of dental radiography are distortion of the object-image and superimposition of shadows of overlying structures. These drawbacks are ever present, and have to be countered by segmental procedures and adjustments in the incidence of the X-ray beam.

The early workers in dental practice were aware of these difficulties, and in 1897 Rollins in the U.S.A. and Bouchacourt in France conceived the idea of introducing a small X-ray tube into the oral cavity and projecting the images of the teeth on to a film placed outside on the face. Unfortunately, their results were poor and the radiation hazards great. It was not possible at that time to construct a focal target sufficiently small to produce sharp

* A paper given at the Annual "At Home", at the Royal Dental Hospital of London on Saturday, May 14, 1960.

pictures, and the procedure was disagreeable for the patient.

The conception of an intra-oral source of radiation was never actually abandoned. From time to time, attempts were made to revive such a method of X-ray examination, especially with the introduction of the hot cathode X-ray

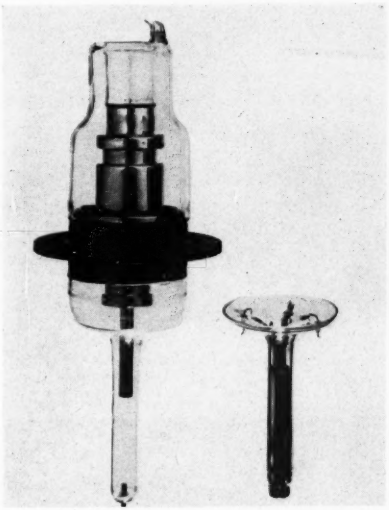

Fig. 1.—The Panoramix X-ray tube with the projecting long arm rod. On the distal end is set the target anode. The smaller picture is that of the protective shield.

tube, but the manufacturers found the proposition complex and costly and the results were discouraging.

In the years immediately following the Second World War, the discovery of a large range of radioactive isotopes stimulated Professor Mayneord to pronounce that "probably by suitable choice of substances (radioactive isotopes), available in sufficient quantity, they might, in some instances, even displace X-ray tubes and enable radiographs of the human body to be taken under entirely different circumstances". In 1951 Professor Mayneord produced a radiograph of the mandible taken with thulium 170 requiring an exposure time of 15 seconds. He followed this up with a similar radiograph using Xenon, and was able to reduce the exposure to 1 second.

The results were most revealing, but isotopes are costly, their life relatively short, and the radiation risks forbidding.

With so much experimental work being carried out from 1946 onwards on dry skull and jaws, it is not surprising to find Dr. Ott, a young dentist in Berne, building for himself

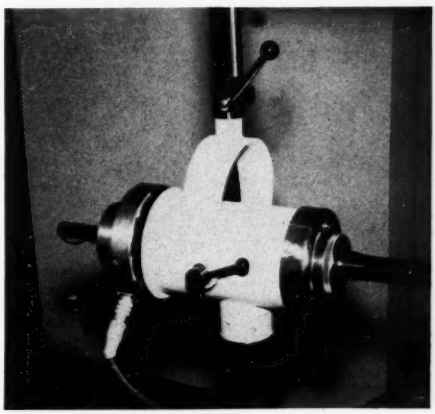

Fig. 2.—The Panoramix X-ray tube in its protective housing. Only 23 mm. of the long rod cone is introduced into the mouth in line with the transverse axes across the second premolar teeth.

in 1948–9 a very simple prototype of a small X-ray tube to be used as a source of radiation from within the mouth. In spite of the fact that he encountered some difficulty with the correct voltage to excite his tube, he proceeded with his project. He explained that although the radiographs lacked fine detail, the results proved to him the merit of his approach.

In 1951 Dr. Ott approached several X-ray concerns to take over the development and manufacture of an X-ray tube capable of being introduced into the mouth.

A Swiss Company decided to concentrate upon the building of an X-ray tube with a long rod anode to be introduced into the mouth, and at the same time to embrace the conventional cathode design and operate on self-rectified voltage.

In Great Britain at this time the possibilities of a rotational tomography were being investigated in relation to a panoramic view of the whole face. The Swiss, however, were

concerned particularly with a similar portrayal of the teeth only. In 1953 a prototype X-ray tube was shown at the technical exhibition of the 7th International Congress of Radiology in Copenhagen, but this precision X-ray tube, and the results therefrom, did not receive the necessary recognition.

Nevertheless, the pictures produced by this new X-ray tube were sufficiently promising to stimulate the Swiss in their determination to pursue their policy. It prompted them to seek and establish technical collaboration with the Institute for Industrial Research at the Swiss Polytechnicum of Zürich,

Fig. 3.—A panoramic view of the maxillary teeth, which are seen from apex to crown in their true vertical position. A good detailed picture is seen of the supporting bone structures. The image is magnified to at least twice the normal size.

Fig. 4.—A panoramic view of the mandibular teeth without distortion or superimposition.

The image definition was not good enough for the clinician and radiologist, and unfortunately it could not be improved upon, since it was impossible to reduce the relatively large focal area on the target. The application of high voltage to the tube frequently resulted in its puncture. This could not be avoided, owing to the small distance between the cathode and the tube walls. Lastly, in those days of increasing interest in radiation hazards, the exposure-time was considered dangerous.

who are acknowledged experts in the electronic field, and particularly in electron-beam design.

It took three years of concentrated efforts to develop and produce the ideal X-ray tube for the purposes required. The "Panoramix" tube, now completed, incorporates indirect heating of the cathode, a homogeneous electron source, a focal spot size of only $\frac{4}{1000}$ in., and a special automatic centring device to assure its permanent position.

A long narrow glass arm projects from the main X-ray bulb and carries the anode or target at its distal end. It is electrically connected to the oil-immersed parts with a thin metal sheath, and the arm is covered with lead foil to prevent divergent radiation, especially upwards to the base of the skull. The anode-target and metal sheath are earthed (*Figs.* 1, 2).

The target has an ultra-fine spot and lies on the summit of the cone and is directed outwards. When activated, the X-rays emanate from the pin-point target and diverge from within outwards to the teeth, with a wide-angle divergence. In this way, they project the images of the teeth on to a film held on the outside of the face. Although the film-focus distance is extremely short, the point-focus is responsible for the sharpness in detail as well as for the magnification of the image, which is at least twice the normal anatomical size (*Figs.* 3, 4).

A polythene mouthpiece with a lead-foil lining is sterilized for each patient, and slipped over the long rod anode arm which the patient himself introduces into his own mouth. The lips are closed down upon the arm, and a film in a flexible cassette is adjusted to lie as close as possible to the upper or lower part of the face, whichever is being radiographed. The cassette is lead-backed so that the patient can hold it in position without receiving any radiation whilst a full panorama picture is taken of the teeth (*Fig.* 5).

The tube is radiating from inside the mouth to the outside so that the volume of tissue radiated is reduced to an absolute minimum value. The soft, long-wave-length X-rays are absorbed by additional filters enclosing the arm.

From experiments carried out so far, the kilovoltage will range between 60 and 70, the current passing through the tube is only 0·5 mA., and the exposure time about 0·5 sec. The whole tube is fully enclosed in a radiogauge housing, reducing radiation hazards.

Arrangements have been made to produce here, in England, the complete apparatus, including a constant potential generator which can be carried on a modern dental X-ray unit. The Panoramix tube will be supplied from Switzerland, and the set will be known as the "Pan-Oral" machine.

The final details of the Pan-Oral technique are still under review and will be published when full clinical trials have been completed.

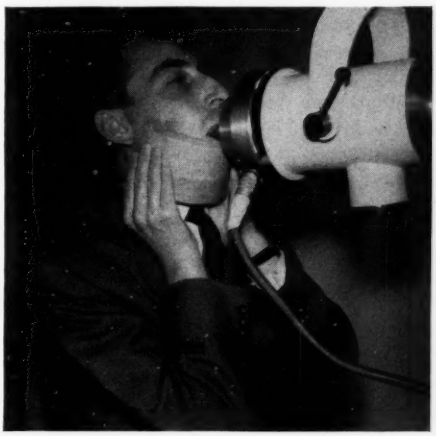

Fig. 5.—With the introduction of the long rod anode into the mouth the film of 10 × 4 in. is adjusted to the outside of the face covered by a lead shield and held in position by the patient himself.

The exact length of arm to be introduced into the mouth, and the best method of retaining it there in a stable position, are still being considered. The kV. to be applied to the tube has yet to be decided upon, and both the bite-block contrived which enables the direction to be adjusted and the returning device for the cassette and the film require some further development.

The dental profession will then have at its command an apparatus capable of producing panoramic, magnified, undistorted, full-length pictures of the teeth from crown to apex, together with the supporting bone structure. Radiographs can be made of both jaws in a standard position, clear in detail, and with good contrast.

The development of the apparatus and its design, together with the establishment of the pan-oral technique, are being undertaken in our Department of Radiology, at the Royal Dental Hospital.

BOOK REVIEW

THE FUTURE OF ORTHODONTICS

A WORKSHOP in Orthodontics was held in June, 1958, at Ann Arbor, Michigan, to study the progress of orthodontics in the United States up to that time and to discuss the current problems and plans for its future. The Workshop was divided into seven groups who were given questions for discussion, and the findings of these groups are set out in the transactions which have been recently published.*

Doctor William Alstadt, D.D.S., who was then President of the American Dental Association, addressing the opening meeting of the Workshop, set the scene for the week's work by drawing attention to the fact that orthodontic treatment was beginning to be looked upon as an integral part of dentistry, and that since dentistry was a part of the total health picture, parents were beginning to feel that they were entitled to an adequate orthodontic service that they could afford.

He cautioned against setting too high a standard requirement for specialist certification, if this meant that a reasonable standard of orthodontic service was going to be denied to the population because few graduates would have the time or the interest to attain a desirable standard of training.

Robert E. Moyers, in welcoming the participants, pointed out that the Workshop was organized so that selected minds could meet to discuss the general state of orthodontics in respect to training both undergraduate and postgraduate students, the role of general practitioners in the orthodontic service, and the growing public demand for treatment. He believed the moment was ripe to come to some conclusions that could be considered as the profession prepared to study dental education in general.

After these two opening statements, the meeting broke up into seven groups, each charged with a specific problem for investigation and to make recommendations.

Group I discussed the aims and objectives of undergraduate orthodontic education. Edward A. Cheyney, who was one of the consultants in the group, suggested that undergraduate education in orthodontics should aim to teach an undergraduate to recognize and, where necessary, to intercept developing malocclusions and that this training should equip him to be able to know when a developing dentofacial complex is in balance. The size and relationship of the jaws to each other and the cranium, and the morphology and activity of the soft tissue environment must all be in balance if a functionally and æsthetically satisfactory occlusion is to develop. Unless a qualified practitioner had this knowledge, he could not hope to give a service to his patients.

The Report of Group I records their views on how the right amount of orthodontic instruction could be fitted into the undergraduate curriculum in the dental schools, and went on to attempt to lay down what the dental graduate should know on qualification.

The research workers reported on how much undergraduate orthodontic teaching was available in the United States and how it was distributed and organized in the different undergraduate schools. The group made recommendations on how much time should be spent in the undergraduate curriculum on orthodontic material, what should be taught in an orthodontic department, and also made general recommendations on the type of staff that would be ideal.

Anyone interested in undergraduate orthodontic education is bound to find stimulating material in the report of this group.

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* *Orthodontics in Mid-Century*. Transactions of a Workshop in Orthodontics. Edited by ROBERT E. MOYERS, D.D.S., Ph.D., Professor of Dentistry (Orthodontics), School of Dentistry, University of Michigan, Ann Arbor, Mich., and PHILIP JAY, D.D.S., M.S., Sc.D. (Hon.), Professor of Dentistry, School of Dentistry, University of Michigan, Ann Arbor, Mich. $8\frac{1}{2} \times 5\frac{1}{2}$ in. Pp. 344. 1959. St. Louis: The C. V. Mosby Co. (London: Henry Kimpton). 65s.

Group II discussed the education of the specialist in orthodontics. T. M. Graber gave a short history of the development of graduate and postgraduate orthodontic education facilities from the time of Edward Angle to the present. He quoted figures that gave an indication of the ever-growing demand for training of specialists, and he charged the group to attempt to lay down some basic principles on the selection of graduate and postgraduate students, the contents and aims of a postgraduate course, and the facilities and type of staff required.

Graber was concerned to discover the appropriate ratio between the time spent on basic subjects and clinical instruction and what part research should play in graduate teaching programmes.

He reminded the group of how difficult it had been to recruit teachers of wide experience and knowledge to act as heads of orthodontic departments and how this had resulted in narrow philosophies being taught, which often led to personal animosities and petty jealousies which affected what was taught. He was most anxious that this should be borne in mind throughout the group's deliberations.

Stephen C. Hopkins followed with some comments on preceptorship training, suggesting that this could never be a substitute for a properly organized university course. The preceptorship principle was a passing phase and should only be perpetuated if university facilities were inadequate to meet the demand.

The Report of Group II sets out in great detail their views on graduate and postgraduate training in orthodontics. It made recommendations on every aspect of this problem in an attempt to suggest ideal standards for graduate schools. Their approach to this assignment is typically American in that they were not afraid to aim at the ideal rather than trying to lay down minimum requirements. Many of the group's recommendations are based on considerations that do not exist in this country, but this chapter will interest anybody who has responsibilities in the organization of graduate orthodontic teaching here.

This chapter contains a mass of collected data, which, if carefully studied, give a clear quantitive analysis of the orthodontic coverage of the American nation. For those who thrive on statistical material set out in tabulated form, there is a wealth of information provided.

Group III discussed the role of the general practitioner in orthodontics. Anderson of Toronto, speaking as one of them, pointed out that the general practitioner was the mainstream of dentistry and that his undergraduate training should equip him to recognize, and often to intercept, developing malocclusions. He criticized the specialist for not having been able to lay down generally accepted basic principles that a general practitioner could watch for in his young patients, so that early malocclusions could be recognized.

The Report of Group III tried to lay down what a general practitioner should attempt. As they considered this problem, they became aware that malocclusions seldom exhibit only one anomaly but are more often a complex mixture of overlapping morphological and functional characteristics. They found that they could recommend very few procedures that general practitioners would be capable of handling. They felt they had to exclude any malocclusion that was associated with an abnormal jaw relationship. If we adopted this attitude in this country an enormous number of successful treatments would never have been started.

Group IV considered orthodontic research. Anders Lundstrom, posing the problems facing orthodontic research, made suggestions on what he considered might be important subjects for investigation. He drew attention to the difficulties inherent in studying the development of the dento-facial complex.

His comments on the need for clinical research are interesting. He pointed out that if truly significant information was to result, it would take years to collect enough material. He infers that European orthodontists, employing simple procedures with removable apparatus, have a considerable responsibility in this direction.

The Report of Group IV does not attempt to make recommendations and passed the problem to the research committee of the American Association of Orthodontists.

Group V considered to what extent the orthodontic facilities in the United States met the demand. They inquired into the size of the orthodontic problem and whether the dental profession could cope with it. The group discussed the lack of information on the incidence of malocclusion, pointing out that there was as yet no exact definition of this condition. Despite this it was convinced that the number of moderate and gross dento-facial abnormalities requiring treatment was far in excess of the profession's ability to meet it.

The group devoted some time to considering the role of the orthodontist in the Public Health Programmes, stressing the need for the co-operation of orthodontic consultants and the sympathetic understanding of public health authorities. They were concerned that orthodontists are tending to lose contact with the dental profession in general by using specialized language. This made it difficult to communicate effectively with allied professional groups, the general practitioner, and the public. The group was also concerned with the socio-economic problems inherent in the health services as they have evolved in the United States.

Included in this section are some valuable statistical tables on the incidence of malocclusion collected by the Burlington Orthodontic Research Center, which would be interesting to anyone contemplating a similar survey in this country.

Group VI was concerned with the relationship of orthodontics to the other health services. Pruzansky in his opening discussion drew attention to the implications of over-specialization and made a plea for the idea that teaching of the basic sciences should be a phase of training where medical and dental students might come together so that contact with allied professions is made at an early stage. He was of the opinion that dental education in the United States tended to produce practitioners who could only thrive in the confinement of their own four walls, rather like shopkeepers.

The Report of Group VI suggests that most of their discussions were concerned with trying to define the role of the pure orthodontist as he comes into contact with his colleagues specializing in medical and other dental fields. It is unlikely that this group's report contains any original ideas of interest to specialists in this country.

Group VII inquired into the professional and public relations of the orthodontist. They were addressed by Lowrie Porter, who came straight to the point, saying that the nation was concerned with the high cost of orthodontics and through the medium of articles in magazines with enormous circulations was asking, "What the dental profession was going to do about it". He gave statistics indicating that there was no chance as things stood that there would be enough credited orthodontic specialists to meet the demand and he suggested that unless the orthodontic fraternity found some way of coping with the problem, the Government, because of public demand, would see that this phase of the dental health services was made adequate.

The group's findings and suggestions are interesting but probably do not apply in this country where a completely different technique of practice administration applies.

The book is attractively presented and very much more readable than one would expect. Specialists coming together to establish a common base from which to go forward in orthodontics has been used in other fields in the United States and it might prove fruitful if some comparable project were organized in this country.

GRANGER MCCALLIN

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SOME OF THE CAUSES AND EFFECTS OF MALOCCLUSION

AN ANALYSIS TAKEN FROM A RANDOM SAMPLE OF 1000 EAST ANGLIAN SECONDARY MODERN SCHOOL CHILDREN

By **D. P. WALTHER**, L.D.S., D.Orth. R.C.S., M.R.C.S., L.R.C.P.
Royal Dental Hospital, London

In the past, especially under those of the Angle school, the treatment of orthodontics was very empirical and largely a practical exercise attempting to arrange all the teeth in a perfect arch regardless of the size of the teeth, the arch, or the muscle environment. Stress was, therefore, laid on technique rather than aetiology and the relapse rate was high.

More recently, progress has been made by laying much more emphasis on the aetiology and treatment planning and thus assessing the prognosis of a case from the outset.

Numerous theories have been and are being put forward, concerning the aetiology of malocclusion, which are based on keen observations, but very little has been done to date to give these a statistical backing. It was decided, therefore, to attempt this by analysing a few of the factors which influence the occlusion of the teeth, taken from a random sample of 1000 East Anglian Secondary Modern School Children. It was also realized that very little work has been done along these lines into the effects of malocclusion on the individual, their teeth, and their surrounding tissues.

A small research project was, therefore, planned and carried out by a team from the Royal Dental Hospital.

The team consisted of Mr. P. M. C. James, Senior Lecturer in Children's Dentistry, Mr. D. A. Plint, Lecturer in Orthodontics, and myself.

The sample of 1000 children was chosen as carefully as possible in the following manner:—

1. All the children were between 11 and 13 years of age.

2. They all came from new Secondary Modern Schools in three East Anglian centres —Colchester, Chelmsford, and Norwich. Their environment was, therefore, much the same.

3. East Anglia was chosen because it tends to be a little more isolated on account of its geographical position.

4. One-third of the children were taken from each of the centres for the following reasons:—

a. Colchester, because it has an adequate to high fluorine content in its water-supply, between 1·2 and 2 parts per million. Therefore, quite a high proportion of children (181) had been exposed to continuous fluorine all their lives. The remainder had fluorine for varying lengths of time.

b. Chelmsford, where the fluorine content is intermediate and intermittent, varying somewhere between 0 and 1 part per million.

c. Norwich, where the fluorine content is definitely very low, only 0·17 part per million.

It was felt that this sample gave us a very valuable cross-section on which to base our project.

James examined the children for the following:—

Caries.—D.M.F. count (i.e., decayed, missing, and filled teeth). Those with a D.M.F. of 9 and over were considered high. Those with a D.M.F. of between 2 and 8 were average. (These were the cases which fell within the standard deviation of the mean for the total group.) Those with a D.M.F. of 1 and less were low.

Gums.—P.M.A. count (i.e., degree of inflammation of papilla, margin, and attachment around the upper and lower incisor teeth). Those with a total P.M.A. count of 5 and over were considered high (poor gums). Those with a total P.M.A. count of between 3 and 4 average. (These cases fell within the

Presidential Address given at the meeting held on January 11, 1960.

CLINICAL ASSESSMENT FORM

NAME (9–10) AGE (11) SEX (1–2) DATE (3–6) No.

(33) SKELETAL CLASSIFICATION [1] Class I [7] Mild II [2] Class II [8] Mild III [3] Class III

(33) FRANKFORT–MANDIBULAR-PLANE ANGLE [4] High [9] Highish [5] Average [10] Lowish [6] Low

(34) OCCLUSAL CLASSIFICATION [1] Class I [2] Class II div. 1 [3] Class II div. 2 [4] Class III [5] Class II indefinite

(35) LIPS [1] Competent [2] Incompetent [3] Slight [4] Gross [5] Habit. tog. [6] Apart [7] Sep. by 21|12 [8] Normal

(36) LIP LINE (TOG.) [1] Above occlusal ½ [2] Occlusal ½ [3] Incisal tips [4] Below

(37) SWALLOWING [1] Tooth together [2] Tooth apart [3] Anterior tongue thrust [4] Doubtful 50|50

(38) CIRCUMORAL CONTRACTION [1] Absent [2] Over 21|12 [3] Incisal tips [4] Under 21|12 [6] Present + [7] Present ++

(38) TONGUE POSITION [5] Between Incisors

(39) HABITS [1] Tongue to lip [2] Thumb or finger [3] Other objects [4] Age when stopped: [5] 0–2, [6] 3–4 [7] 5–6 [8] 7–8 [9] 9 +

(40) HABITUAL REST POSITION [1] Normal [2] Forward [3] Open

(42) BREATHING [1] Nasal [2] Oral [3] Oral-nasal [4] Nasal infection

(44) SPEECH [5] Normal [6] Anterior sigmatism [7] Dyslalia [1] Cleft palate [8] Others

(45) ORAL HYGIENE [3] Good [4] Average [5] Poor

(46) UPPER INCISORS [1] Normal [2] Proclined [3] Retroclined [4] Crowded [5] Spaced [7] Diastema [9] Fractures [8] Local abnormalities

(49) LOWER INCISORS [1] Normal [2] Proclined [3] Retroclined [4] Crowded [5] Spaced [9] Fractures

(52) OVERBITE [1] Normal [2] Increased complete [3] Increased incomplete [4] Reduced [5] Edge to edge [6] Open bite

(53) OVERJET [1] Normal [2] Increased slight [3] Increased gross [4] Reversed [5] Edge to edge

(56) EARLY LOSS DEC. [1] Maxilla [4] Crowding [5] Mandible [8] Crowding

(63) CARIES D.M.F. [3] High (9 +) [4] Average (8–2) [5] Low (1 —)

(63) GUMS P.M.A. [6] High (5 +) [7] Average (4–3) [8] Low (2 —)

(64) TREATMENT [1] None required [2] Previous orthodontic treatment [10] Requires orthodontic treatment [11] Treatment by extraction only

(65) FLUORINE [1] High continuous from birth [2] High after birth [3] Average [4] Low

(65) GROUP [5] Colchester [6] Chelmsford [7] Norwich

Fig. 1.—Assessment form used in research analysis.

standard deviation of the mean for the total group.) Those with a total P.M.A. count of 2 and less were low (good gums).

He also noted the presence of calculus, stain, mottling, fractured incisors, oral hygiene, etc.

Plint and I gave as complete an orthodontic examination as possible. This was adjusted so that we took twice as long as James. This meant that the children could progress straight through without any hold-up and, therefore, minimal interference with school work. The schools put their medical inspection rooms at our disposal for this purpose.

ORTHODONTIC EXAMINATION

This examination was purely clinical and we confined it to what we felt to be the minimal essentials. The assessment form used is shown in *Fig.* 1. Most of this is self-explanatory.

The dental base relationship was assessed by Ballard's method of correcting the axial inclination of the incisors and then determining the degree of overjet present. It will be noticed that it was divided into 5 groups. Skeletal I, when after correction the overjet was normal. Skeletal II, when after correction there was considerable overjet. There was no question at all in these cases that the dental base relationship was post-normal, and if a lateral skull tracing could have been available the long axis of the lower incisor would have passed palatal to the crown of the upper incisor. The mild Skeletal II group were those cases which fell between these two groups.

Skeletal III, when after correction the overjet was considerably reversed, and there was no doubt that the dental base was pre-normal. The mild Skeletal III group were those which lay between these and the Skeletal I cases.

From 100 hospital cases the difference has been worked out between my clinical assessment of dental base relationship and that obtained from lateral skull tracings. My total accuracy, including margin of error, was 93 per cent. My greatest difference was placing some of the definite Skeletal II cases as mild Skeletal II, and some definite Skeletal III cases as mild Skeletal III.

The difference appears to be connected with the morphology of the incisor teeth.

The size of the Frankfort–mandibular-plane angles was also assessed clinically, and divided into 5 groups, so as to separate the definitely high from the definitely low.

The High group = approximately 33·5° and above.

The Moderately High group (Highish) = approximately 29·5–33°.

The Average group = approximately 25–29°.

The Moderately Low group (Lowish) = approximately 21–24·5°.

The Low group = approximately 20·5° and under.

The total accuracy, including margin of error, between my clinical assessment and that taken from the lateral skull tracing was about 94 per cent.

Angle's classification was used for the occlusion, but I found I had to add a Class II indefinite group for those cases which would not fit into either Class II, division 1 or Class II, division 2 groups.

Upper incisors were said to be proclined if their axial inclination with the Frankfort plane was more than 111°, and retroclined if less than 103°.

The total accuracy between my clinical assessment and that from a lateral skull tracing was about 73 per cent, because I tended to assess all groups as slightly more retroclined than the tracing showed. This appears to be related to the morphology of the crowns.

As regards the lower incisors, these were adjusted mentally inversely with the Frankfort–mandibular-plane angle, and were said to be proclined if when the Frankfort–mandibular-plane angle was normal their axial inclination to the mandibular plane was more than 95°, and retroclined if less than 85°. Here my total accuracy was lowest at only 51 per cent, again tending towards retroclination, and may be associated with the morphology of their crowns.

The following definitions were used when assessing soft tissue morphology:—

Competent Lips.—"A soft tissue morphology that permits the lips to seal with the

mandible in the rest position, without any active contraction of the oro-facial musculature." It might be better and less confusing if we used the term "adequate lip morphology" in these cases.

divided into 2 groups, slight and gross, also whether usually together, apart, or separated by 21|12.

Some of the "competent" lips appeared normal, whilst others appeared overcompetent,

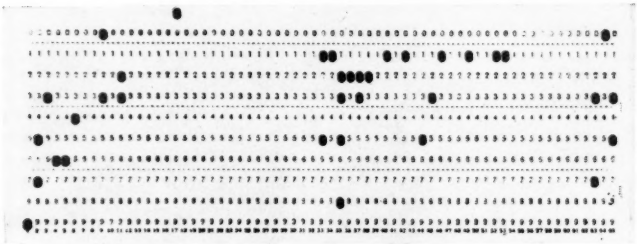

Fig. 2.—Example of the punch card used.

Fig. 3.—Girl feeding material from the assessment form on to the punch card.

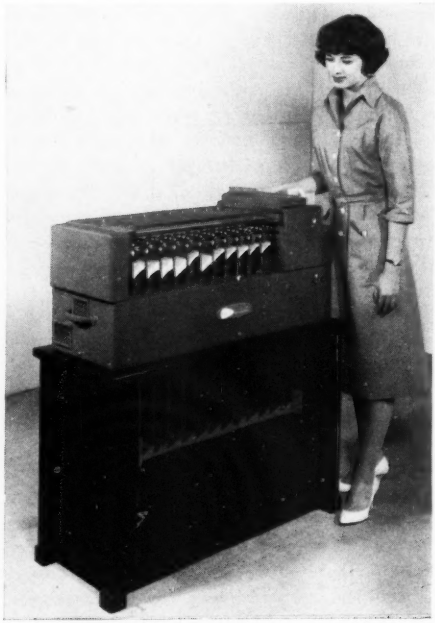

Fig. 4.—The Powers-Samas sorter. (*Figs.* 3 *and* 4 *by kind permission of Messrs. Powers-Samas.*)

Incompetent Lips.—"Here the lips are parted at rest with the mandible in the physiological rest position." Here again it might be less confusing to use the term "inadequate lip morphology". The "incompetent" lips were

and quite a large number of the slightly incompetent lips appeared normal. So "normal" was added to the assessment form.

Swallowing Behaviour.—Whether the teeth came into light occlusion or not, and whether

there was a tongue thrust present, was assessed.

If the tongue lay between the incisors at rest, this was also noted.

The assessment form was then punched on to a Powers-Samas punch card (*Fig.* 2), and the various facts required extracted by the sorter and then brought to percentages. *Figs.* 3 and 4 show the way this was done.

Fig. 5 shows a pseudo-graph of the dental base relationships compared as percentages. These graphs are not true graphs in the accepted sense. What has been done is to join the summits of the various histograms. It was felt this was the clearest way of presenting and comparing the various percentage distributions. It will be noticed that out of the total group of 1000 cases, 356 were Skeletal I, i.e., 35·6 per cent. Definite Skeletal II and mild Skeletal II were 25·6 per cent and 27·7 per cent respectively, whilst definite Skeletal III and mild Skeletal III were only 4·3 per cent and 6·8 per cent respectively. (These figures are reasonably accurate as the standard error is less than 3 per cent.)

It will be noticed how the total Skeletal II tendency predominates, whilst the total Skeletal III tendency is only about 10 per cent. I have kept the 5 groups apart in order to observe any particular swing. Plint and I examined 498 and 502 cases respectively. Unfortunately, we could not both examine all the cases because of time and organization. Obviously this would have been the ideal had it been possible. However, we had previous evidence that our assessments compared fairly closely. Another factor which must be borne in mind is the fact that I examined 16 per cent more of the Colchester children, whilst Plint examined 8 per cent more of both the Norwich and Chelmsford children. The differences in these groups may also have contributed to our slight variation, or vice versa.

It will be noticed that we were much the same as regards the percentage of Skeletal I cases, but that I was slightly higher in definite Skeletal II assessment, whilst he was slightly higher in mild Skeletal II assessment. This may well be influenced by the higher relative percentage of definite Skeletal II cases in Colchester as compared with the higher relative percentage of mild Skeletal II cases of Chelmsford and Norwich.

The same slight difference will be noticed in the Skeletal III and mild Skeletal III groups.

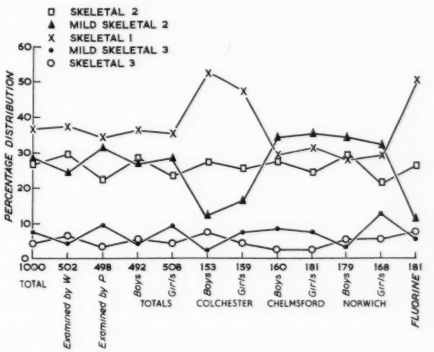

Fig. 5.—Dental base relationships compared.

It is also interesting to notice that a predominantly definite Skeletal II dental base relationship tends to show itself more in the boys of the various groups, and the higher the percentage the more it appears to come out in the males. This is also seen, but to a less extent, with Skeletal III cases. It is also found to be the case when the various Frankfort–mandibular-plane angle groups are compared.

In comparing the 3 groups of children it will be seen that in Colchester the percentage distribution of Skeletal I cases was significantly very high—51·5 per cent for boys and 47 per cent for girls—whilst those of the mild Skeletal II were very low, forming, as it were, a mirror image.

In both the Chelmsford and Norwich groups it will be seen that the percentage of mild Skeletal II cases is higher than average, whilst the percentage distribution of Skeletal I cases is lower than average. The percentage distribution of the definite Skeletal II cases remains extraordinarily steady.

Since there were 181 children in the Colchester group who had been continuously exposed to fluorine from before birth, it was decided to work out the percentage distribution of the various skeletal groups for these

children. It was found that out of the 181 continuous fluorine cases:—

91 were Skeletal I—50·3 per cent.
20 were mild Skeletal II—11·1 per cent.
48 were definite Skeletal II—26·5 per cent.
13 were mild Skeletal III—7·2 per cent.
9 were Skeletal III—5 per cent.

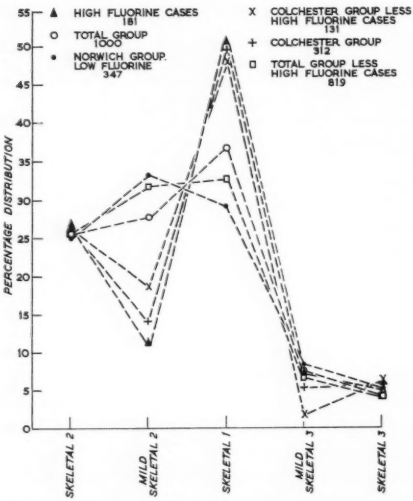

Fig. 6.—Dental base relationship of high and low fluorine groups compared.

This showed a significant rise in the percentage of Skeletal I cases from 35·6 per cent in the total group to 50·3 per cent, and a significant fall in the mild Skeletal II cases from 27·7 per cent in the total group to 11·1 per cent (over 8 per cent rise is significant in this case). This is a very similar picture to that of the Colchester group.

This change in the percentage distribution of Skeletal pattern may be accounted for by either the difference in the ethnic groups, or it might be due to the different fluorine content of the water-supply.

It may well be that the fluorine content has encouraged the mild Skeletal II cases to become Skeletal I, but does not affect the definite Skeletal II cases which are beyond help. This might have been caused by a slight lag in the development of the maxilla or encouragement to the growth of the mandible. The ideal situation might be to have a favourable ethnic group with a high percentage of mild Skeletal II cases on which the fluorine can act to make them become Skeletal I.

Another graph was, therefore, drawn (*Fig.* 6) to compare the following groups:—

1. Those who had continuous fluorine from before birth—181 cases (▲).
2. The total Colchester group—312 cases (+).
3. The total Colchester group without those who had continuous fluorine from before birth —131 cases, but it should be realized that these cases had been exposed to fluorine for varying lengths of time (×).
4. The total group of 1000 cases (○).
5. The total group without those who had continuous fluorine—819 cases (□).
6. The total Norwich group of 347 cases. Here the fluorine content of the water is very low (●).

The following points are of interest, but it must be realized that the standard error per cent varies from between 3 per cent and 8 per cent according to the size of the percentage and the size of the group.

1. The percentage of cases having a definite Skeletal II dental base relationship is about the same for all groups, 25–26 per cent.

2. The picture presented by the percentage of cases having a mild Skeletal II skeletal pattern is very different. Here the total Norwich group and the total group without the continuous fluorine cases (819) are highest at 33 and 31 per cent, followed by the total group (1000) at 27·5 per cent. Then comes the Colchester group without the continuous fluorine cases (131) at 19 per cent, with the total Colchester group (312) 14 per cent, and the continuous fluorine cases (181) 11 per cent being the lowest of all.

3. The percentage of cases having a Skeletal I dental base relationship is completely the reverse way round. The continuous fluorine group, the total Colchester group, and the Colchester group without continuous fluorine comprise about 49 per cent, whilst the other 3 groups, i.e., the total group, the total group without continuous fluorine, and the Norwich group, are lowest at about 29 to 35 per cent.

4. The percentage distribution of the mild Skeletal III cases is very indefinite and has a much wider variation for the various groups than that of the definite Skeletal III cases which is localized in much the same way as the definite Skeletal II cases.

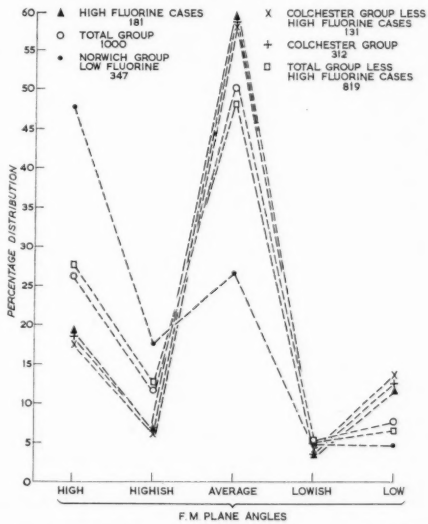

Fig. 7.—Frankfort–mandibular-plane angles of high and low fluorine groups compared.

It must be remembered that whilst the 181 cases had continuous fluorine since birth, the vast majority of the total Colchester group were also exposed to fluorine for varying lengths of time whilst they were living in Colchester. The Colchester group without continuous fluorine from birth (131 cases) were, therefore, exposed to fluorine for a varying length of time during their development.

There is not, therefore, sufficient evidence in this survey to be able to say whether this improvement in skeletal pattern is due to the fluorine intake or whether it is just the local ethnic group. A further survey is necessary in another fluorine area, but it does give us food for thought. It might be a useful aid to treatment if the day should come when we can give a drug to improve the skeletal form.

The effect of fluorine and/or ethnic group on the size of the Frankfort–mandibular-plane angles is also interesting, and can be seen in *Fig.* 7.

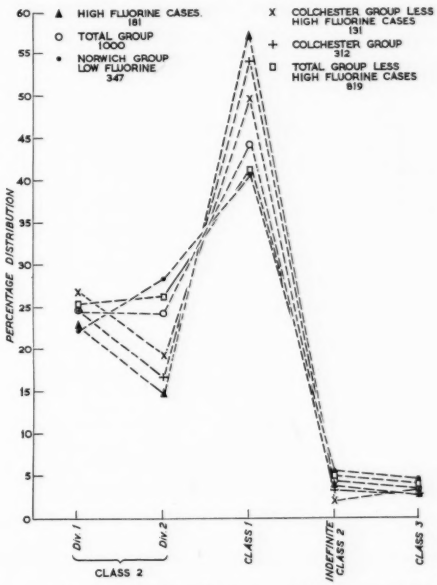

Fig. 8.—Occlusal classifications of high and low fluorine groups compared.

It will be noticed that the Norwich group which has low-fluorine water and the total group without the fluorine cases have the highest percentage of high and highish Frankfort–mandibular-plane angles, slightly higher than the total group cases, whereas the fluorine group and the Colchester groups have a much lower percentage. This again may be due to either ethnic or fluorine influence, or both. It will also be noticed in this graph that the percentage of average Frankfort–mandibular-plane angles is also highest in the fluorine and Colchester groups, about 59 per cent. The percentage of low Frankfort–mandibular-plane angles is also highest in the fluorine and Colchester groups.

The effect of fluorine and/or ethnic group on the various Angle's occlusal classification classes can be seen in *Fig.* 8.

It will be seen that the percentage of Angle Class I cases is highest in the fluorine group, 57 per cent, followed by the Colchester group only, 54 per cent, and then the Colchester group without fluorine, 49 per cent. Then

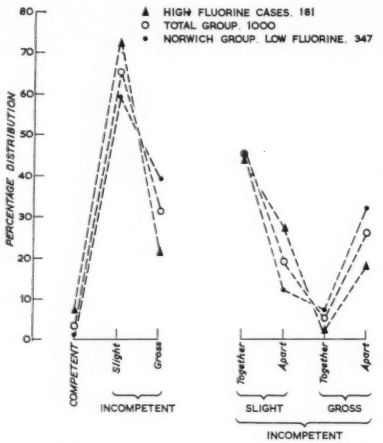

Fig. 9.—Various lip morphologies of high and low fluorine groups compared.

comes the total group at 44 per cent and the lowest percentage is found in the total group without fluorine and Norwich (low fluorine) cases at 41 per cent. It certainly looks as if fluorine may be playing some part in the percentage of Class I cases from this distribution. It is interesting to note that in the recent report on the Evanston fluorine study, there was a definite lowering of the incidence of malocclusion, which was not just due to the known effect of fluorine on the caries incidence and, therefore, on the early loss of teeth which is only thought to be only a minor factor in causing malocclusion.

It will also be noticed that the percentage distribution of the Class II, division 2 cases is lowest in the fluorine group and highest in the Norwich low fluorine group. This may be connected with the predominance of a mild Skeletal II dental base in these cases which might possibly have been favourably influenced by a fluorine intake, whereas the higher incidence of definite Skeletal Class II dental base relationships of the Class II, division 1 and indefinite Class II cases is too gross to be affected. Of course, we must examine more ethnic groups in other fluorine areas before we can really draw any definite conclusions. It is to be hoped that Norwich may, at some time in the future, fluorinate its water supplies, in which case a repeat assessment would be of great interest.

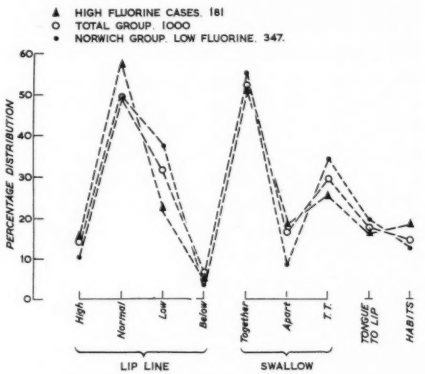

Fig. 10.—Various lip morphologies and swallowing behaviours of high and low fluorine groups compared.

Other graphs were then made, comparing the percentage incidence of other factors in the continuous fluorine group of 181 cases, as against the total group of 1000 cases, and the low fluorine Norwich group of 347 cases.

Fig. 9 shows a pseudo-graph of the percentage distribution of the various different lip morphologies. It will be noticed that the percentage distribution of cases with competent and slightly incompetent lips was higher in the fluorine group, whilst in those with grossly incompetent lips it was much lower. This may well be due to the higher percentage of Skeletal I dental bases and average and lowish Frankfort–mandibular-plane angles in the fluorine group. Whether the lips are usually held together or apart does not appear to influence the percentage distribution very much, but the percentage distribution of the slightly incompetent lips, which are held habitually together, appears lower in the fluorine group than I would have expected.

Fig. 10 shows a graph of the percentage distribution of the various positions of the lip

line and swallowing behaviours. It will be noticed that, in the fluorine group, the percentage distribution of a normal lip line is higher than in the total group but of a low lip line much lower, again, probably due to the skeletal pattern. The percentage distribution of the tooth-apart type of swallow was lower in the low fluorine group, but when present with a tongue thrust it was higher.

The percentage distribution of upper incisors with a normal axial inclination was higher in the fluorine group but fractures of upper incisors were lower. The same applied to the lower incisors, but to a lesser extent.

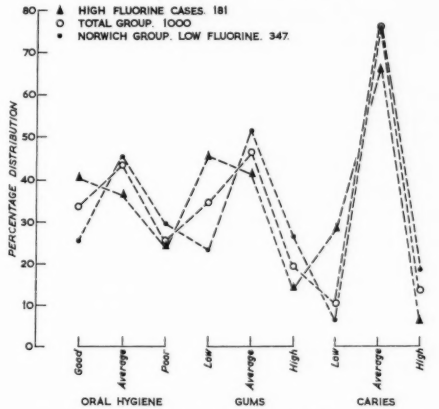

Fig. 11.—Oral hygiene, gums P.M.A., caries D.M.F., of high and low fluorine groups compared.

In *Fig.* 11, as would be expected, the percentage of cases having a low D.M.F. caries count (1 and under) is much higher in the continuous fluorine group, whilst those with an average D.M.F., i.e., between 2 and 8, or high count, 9 and above, were much lower.

It will also be noticed that the percentage of cases having a low P.M.A. count, i.e., 2 or below of the gingivæ round the upper and lower incisors, was much higher in the continuous fluorine group. As with caries, the average P.M.A. cases, i.e., between 3 and 4 and the high cases of 5 and above, were both much higher in the total group than in the continuous fluorine group. It is interesting how the percentage distribution of cases with good oral hygiene is higher in the continuous fluorine group, at the expense of the average and poor cases.

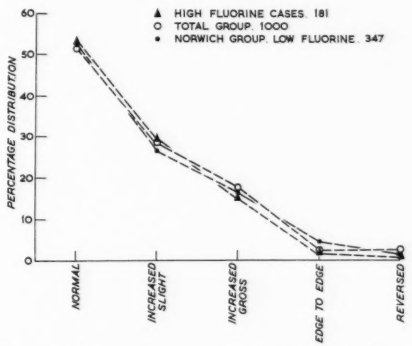

Fig. 12.—Various degrees of overjet of high and low fluorine groups compared.

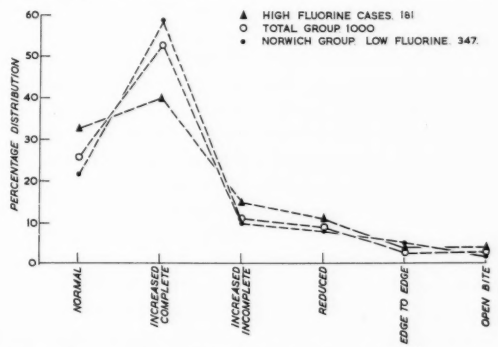

Fig. 13.—Various degrees of overbite of high and low fluorine groups compared.

In *Fig.* 12 it will be noticed that the percentage of the various types of overjet was extraordinarily similar in the 3 groups, as would be expected seeing that the definite Skeletal II and definite Skeletal III dental bases are not affected; in *Fig.* 13, on the other hand, the percentage distribution of the definite Skeletal II cases are not significantly affected.

Moderately High (Highish) Frankfort–Mandibular-plane Angles.—It is interesting how the definite Skeletal III percentage has dropped to below average whilst the mild Skeletal III percentage remains up. The same

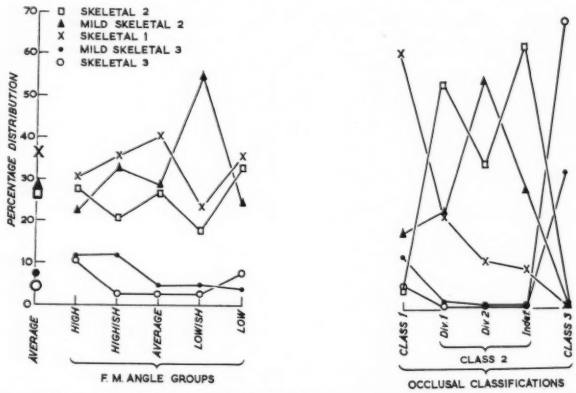

Fig. 14.—The different dental base relationships in various Frankfort–mandibular-plane angle and occlusal groups compared.

various types of overbite varies considerably. The percentage of cases with normal and increased incomplete overbite was higher in the continuous fluorine group, but the percentage of increased complete overbite cases was much lower. This again is probably due to the relative increase in the Skeletal I cases in the continuous fluorine group.

In *Fig.* 14 the percentage distribution of the various skeletal groups is plotted against the Frankfort–mandibular-plane angles and Angle's occlusal classifications. It is probably clearer to take the various Frankfort–mandibular-plane angles and occlusal groups individually and compare the various skeletal percentage distributions against the average for the various groups. The percentage distribution of the various skeletal classes in the total group can be seen in the first column.

High Frankfort–Mandibular-plane Angles.—This is up in both the Skeletal III and mild Skeletal III groups, as would be expected. There is, therefore, a drop in the percentage of Skeletal I and mild Skeletal II cases. The distribution is found with the definite Skeletal II and mild Skeletal II cases, whilst the Skeletal I distribution is average. In other words, there is a general improvement of the skeletal pattern.

Average Frankfort–Mandibular-plane Angles.—Here, as would be expected, the percentage distribution is higher amongst the Skeletal I cases, about average for the Skeletal II and mild Skeletal II, and slightly lower for Skeletal III and mild Skeletal III ones.

Moderately Low (Lowish) Frankfort–Mandibular-plane Angles.—Here the percentage distribution of the mild Skeletal II cases is very much higher than that for the total group. All the other skeletal groups are, therefore, depressed. This is probably the reason why a lowish Frankfort–mandibular-plane angle is so often found in Class II, division 2 cases.

Low Frankfort–Mandibular-plane Angles.—Here the percentage distribution of Skeletal I cases is about the same as for the total group. It is, however, higher for the definite Skeletal

II and Skeletal III cases, but is slightly lower for the mild II and mild III cases. This is interesting, because it shows the group of Skeletal III cases with a low Frankfort–mandibular-plane angle. Also clinically quite a number of gross Skeletal II cases have a low Frankfort–mandibular-plane angle.

OCCLUSION

Class I.—As was expected, the percentage distribution of the Skeletal I cases was much higher than that for the total group. The distribution of mild Skeletal II was lower, and for definite Skeletal II cases lower still. On the other hand, the distribution of mild Skeletal III was up, whilst that of the definite Skeletal III was about normal.

It would seem, therefore, that the prognosis for a Class I occlusion is much more favourable if there is a Skeletal I or mild Skeletal III dental base. Should the skeletal pattern tend towards a Skeletal II, then prognosis is comparatively poor.

Class II, division 1.—Here the definite Skeletal II distribution is much higher, showing how important an aetiological factor this is, either on its own account or in influencing an abnormal lip morphology and behaviour. The percentage distribution of mild Skeletal II cases is slightly below the total group, which is interesting, whilst that of the Skeletal I cases is definitely low, and mild Skeletal III and Skeletal III almost non-existent.

Class II, division 2.—Here it is interesting how the mild Skeletal II percentage distribution goes right up whilst the definite Skeletal II drops, but is still higher than that for the total group. The Skeletal III groups are very low or even non-existent.

Indefinite Class II.—These are the cases which would not fit into either division 1 or division 2. Here the definite Skeletal II dental base distribution is much higher and would seem to be a much more important factor.

Class III.—As one would expect, the Skeletal III and mild Skeletal III cases have a much higher distribution, whilst the others are non-existent.

NORMAL LIP MORPHOLOGY AND BEHAVIOUR

As already explained, this group included some competent and some slightly incompetent cases. Only 18 per cent of cases were assessed as absolutely normal in both morphology and behaviour. Perhaps we were too strict in our assessment of normal.

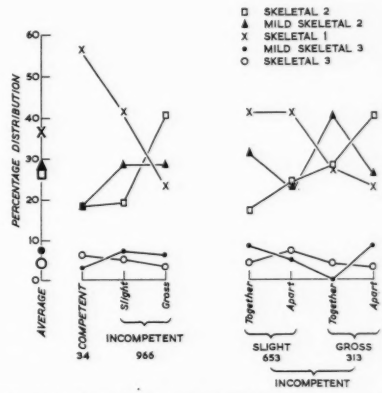

Fig. 15.—Dental base relationships of various lip morphologies compared.

Fig. 15 shows the dental base relationship plotted against the soft-tissue morphology.

Competent Lips.—In *Fig.* 15 the percentage distribution of both definite Skeletal II and mild Skeletal II cases is well down, whilst that for the Skeletal I group is well up.

Incompetent Lips.—The numbers of cases which fell into this group by definition were extremely large, consisting of 966 cases out of the 1000. The distribution was, therefore, almost identical to the total group. They were subdivided into slight and gross and whether usually together or apart.

Slightly Incompetent Lips.—Here the percentage distribution of the definite Skeletal II cases is still below the average for the total group, but that of the Skeletal I group is slightly up, but not as high as for the competent lips. The mild Skeletal II group has also gone up to average.

Grossly Incompetent Lips.—In contrast to the previous group, it will be noticed that the percentage distribution of the definite Skeletal

II cases is very much higher, whilst that of the Skeletal I cases is very much down. The other skeletal groups do not differ very much. When these last two groups were subdivided again into whether the lips were usually together or apart, the main point of interest was the different percentage distribution of the definite Skeletal II cases. These were much higher in both groups when the lips were usually held apart, at the expense of the mild Skeletal II cases, which was much higher in both groups when the lips were together.

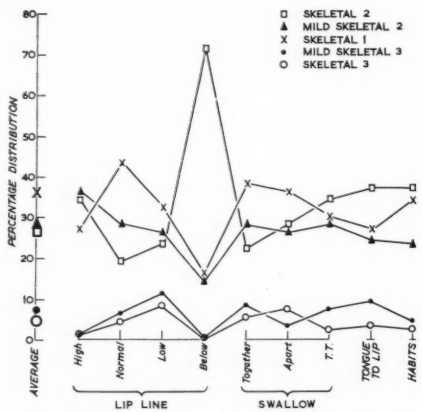

Fig. 16.—Dental base relationships of various lip morphologies and swallowing behaviours compared.

In those cases where the lips were separated by 21|12, the definite Skeletal II distribution was extremely high at over 70 per cent, as would be expected.

There would, therefore, appear to be a very close correlation between a definite Skeletal II dental base relationship and the soft-tissue morphology.

Fig. 16 shows the dental base relationship plotted against the position of the lip line and the type of swallowing activity.

Lip Line High, that is to say, above Occlusal Half of the Crown of the Upper Incisor.—One hundred and forty-three cases fell into this category—14·3 per cent. It will be noticed that the percentage distribution of both the definite Skeletal II and mild Skeletal II cases is much higher than the total group, whilst that of Skeletal I and the two Skeletal III groups is lower. It will be remembered that the percentage distribution of low and lowish Frankfort–mandibular-plane angles is higher in the two Skeletal II groups, so this may account for the distribution found.

Lip Line Normal, that is to say, over the Occlusal Half of the Crown of the Upper Incisors.—Four hundred and ninety-one cases come into this group—49·1 per cent. It will be seen that the percentage distribution of the definite Skeletal II cases has fallen well below the total group, whilst that for the Skeletal I cases has risen higher. The two Skeletal III groups and the mild Skeletal II cases are about the same as the total group.

Lip Line Low, that is to say, over the Upper Incisor Tips.—Three hundred and eight cases fell into this group—30·8 per cent. The alteration here is that the percentage distribution of the two Skeletal III groups has risen to above that for the total group, whilst that of the Skeletal I cases has fallen.

Lip Line below the Upper Incisors.—Only 58 cases fell into this group—5·8 per cent. It will be noticed how the percentage distribution of the definite Skeletal II cases has risen right up to over 70 per cent, whilst that for all the other groups has dropped very low.

The percentage distribution of the various skeletal group are now plotted against the types of swallowing behaviour, tongue thrust, and tongue positions.

Swallowing Behaviour with Buccal Teeth together and no Evidence of an Anterior Tongue Thrust.—Five hundred and seventeen cases fell into this group—51·7 per cent. It will be noticed that the percentage distribution of the various skeletal groups is slightly more favourable than for the total group, in that the Skeletal I cases is slightly higher, whilst that of the definite Skeletal II is lower. This alteration is so slight as not to be significant, which is rather interesting.

Swallowing Behaviour with Buccal Teeth apart and no Anterior Tongue Thrust.—One hundred and fifty-seven cases came into this group—15·7 per cent. It will be noticed that the percentage distribution in these cases is rather similar to the previous tooth-together

group except that for the definite Skeletal II and definite Skeletal III cases it is slightly higher.

Swallowing Behaviour with Buccal Teeth apart and with some Degree of Anterior Tongue Thrust.—Here the percentage distribution of the definite Skeletal II cases has increased even more at the expense of Skeletal I and definite Skeletal III.

Swallowing Behaviour with Buccal Teeth together and with some Degree of Anterior Tongue Thrust.—There were only 4 cases out of the total 1000 which came into this group. It was difficult to say whether there was an actual tongue thrust, or whether the tongue was just coming forward through the gap. One of these had a mild Skeletal III dental base, whilst the other 3 were Skeletal I.

There were 32 cases in which the swallowing behaviour was so doubtful and indefinite that they could not be put into any of the other groups. In these cases the percentage distribution of the definite Skeletal II cases was considerably below the total group, at the expense of the mild Skeletal III cases in which it was much higher.

Tongue Position between the Incisor Teeth at Rest.—One hundred and sixty-nine cases fell into this group—16·9 per cent. In this group the percentage distribution of the definite Skeletal II cases was even higher, about 37 per cent.

There is here, therefore, some further evidence of a correlation between a definite Skeletal II dental base and abnormal soft-tissue morphology and behaviour.

The percentage distribution of the various skeletal groups was also plotted against the presence and duration of sucking habits. The main variation from the total group was a significant rise in the percentage distribution of the definite Skeletal II cases in those where sucking habits persisted over the age of 9 years.

OVERJET

Fig. 17 shows the percentage distribution of the various skeletal groups plotted against the different types of overjet.

Normal Overjet.—Five hundred and fourteen cases came into this category—51·4 per cent. Here, as would be expected, the percentage distribution of the Skeletal I and the mild Skeletal III cases is higher than that for the total group. For the mild Skeletal II and the definite Skeletal III cases it is about the same, whilst that of the definite Skeletal II group is much lower.

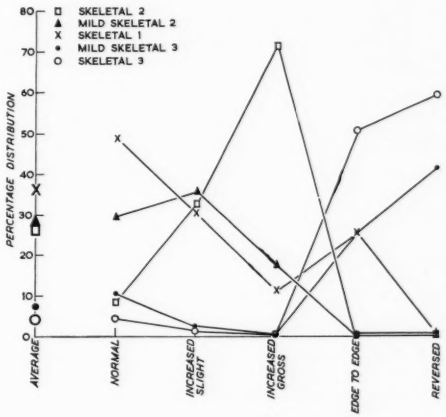

Fig. 17.—Dental base relationships of various types of overjet compared.

Slight Increase in Overjet.—Two hundred and seventy-six cases came into this category—27·6 per cent. These were the cases which had an increase in overjet, but which was less than 3 mm. Here the percentage distribution of the mild Skeletal II and definite Skeletal II cases has gone up at the expense of the Skeletal I and both the Skeletal III groups, in which it has gone down to below the average.

Gross Increase in Overjet.—The overjet is more than 3 mm. in these cases. One hundred and seventy-three cases came into this category—17·3 per cent. Here the percentage distribution of definite Skeletal II cases is very high at 72·5 per cent, whilst for the mild Skeletal II and Skeletal I cases it is much lower than average and both the Skeletal III groups are non-existent.

Reverse Overjet.—Only 17 cases came into this category—1·7 per cent. As would be expected, both the Skeletal III and mild

Skeletal III groups are much higher than average, whilst all the other groups are non-existent.

Edge-to-edge Overjet.—Only 20 cases came into this category—2 per cent. Here the Skeletal I group came into the picture slightly, otherwise the distribution is much the same as for reverse overjet.

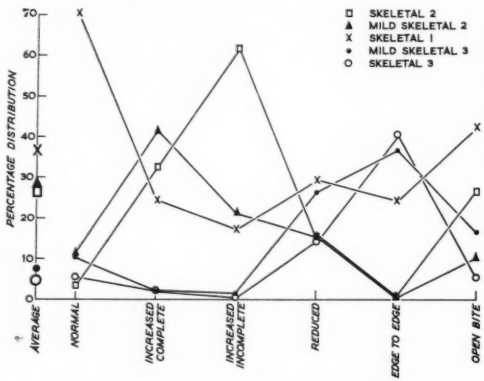

Fig. 18.—Various dental base relationships of different types of overbite compared.

OVERBITE

Fig. 18 shows the percentage distribution of the various dental base relationships in the different groups of overbite compared.

The mild Skeletal III group was also slightly up, whilst the Skeletal III cases was about normal, and the mild Skeletal II and definite Skeletal II groups very low.

The mild Skeletal III group is up, probably because of a compensating retroclination of the lower incisors, due, often, to a normal muscle environment.

Increased Complete Overbite.—This was found in as many as 525 cases, i.e., 52·5 per cent. Both the definite Skeletal II and mild Skeletal II cases were higher than the total group at the expense of the Skeletal I cases. The mild Skeletal III and Skeletal III groups were slightly down.

Increased Incomplete Overbite.—These were the cases where the overbite was increased, but in which the lower incisors did not make contact with either the upper incisors or palate. One hundred and fifty cases came into this group—15 per cent.

It is interesting how very high the percentage distribution of definite Skeletal II cases is at about 60 per cent. All the other groups were depressed, especially both the Skeletal III groups which were almost non-existent. You will remember that the percentage distribution of definite Skeletal II cases was high at 37 per cent in the group that had a tongue-to-lower-lip tongue position.

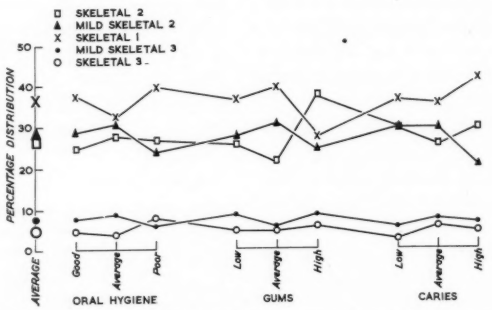

Fig. 19.—Dental base relationships in various degrees of oral hygiene, gums P.M.A., caries D.M.F.

Normal Overbite.—Two hundred and fifty-three cases came into this category—25·3 per cent. Here the percentage distribution of the Skeletal I cases was very high at 70 per cent. There is probably an association here for this very high Skeletal II percentage.

Reduced Overbite.—Seventy-eight cases fell into this group—7·8 per cent. Again, it is

interesting that the percentage distribution of the mild Skeletal III and definite Skeletal III cases is considerably up at the expense of the mild Skeletal II and definite Skeletal II groups, whilst for the Skeletal I cases it is about average.

It would, therefore, appear that in this group both the Skeletal III dental base relationships with their associated tendency to have high or highish Frankfort–mandibular-plane angles play a considerable part in the aetiology.

Edge-to-edge Overbite.—Only 25 cases fell into this group. Here the percentage distribution of mild Skeletal III and definite Skeletal III cases is even higher, whilst both the Skeletal II groups are non-existent. Here, again, the skeletal pattern is playing the major part in the aetiology.

Anterior Open Bite.—Only 19 cases fell into this group. Here, as would be expected, a mixture of muscle behaviour and skeletal form is seen as the aetiological factor.

The percentage distribution of mild Skeletal III and definite Skeletal III cases is higher than average, but not to the same extent as in the previous two groups. For the Skeletal I and definite Skeletal II cases it is also up, but not as much, whilst the mild Skeletal II group is low.

Fig. 19 shows the percentage distribution of the various skeletal classifications in the different oral hygiene, P.M.A., and D.M.F. groups compared.

The main point to notice is the rise in the distribution of definite Skeletal II cases in the high P.M.A. (bad gums) group.

I have only had time in this paper to show you the percentage distribution of the various skeletal groups plotted against a few of the other factors collected during our clinical examination. But it has, I think, shown the importance of dental base relationship in the aetiology of occlusion. I have continued this analysis by plotting the various other factors against each other with some very interesting results.

Finally, I thought it would be rather interesting just to see how many moderately ideal occlusions I could find in these 1000 children. *Table I* shows the way I extracted them. You will notice that there were only 36, i.e., 3·6 per cent.

I have analysed these 36 cases and would like to draw your attention to just one of the features on account of the recent correspondence in the *British Dental Journal*. This was the fact that 8 of them had persistent sucking habits which lasted beyond the age of 9 years, i.e., 22 per cent as against 13·7 per cent for the total group. This is interestingly high, but it must not be forgotten that the group only consisted of 36 cases. From the analysis of the total 1000 cases, persistent sucking-habits as with abnormal muscle behaviours are statistically much more common in patients with a definite Skeletal II dental base relationship, but are then usually associated with an abnormal muscle activity.

Table I.—Data derived from the Powers-Samas Sorter giving Details of Moderately Ideal Occlusions with Variations found in the 1000 Children

Occlusal Class I	440
Overbite normal	235
Overjet normal	227
No upper incisor crowding	132
No upper incisor spacing	106
No upper incisor rotations	106
No upper incisor diastema	106
No upper incisor local abnormalities	104
No lower incisor crowding	77
No lower incisor spacing	76
No maxillary buccal segment crowding	66
No mandibular buccal segment crowding	64
Upper incisors normal axial inclination	54
Lower incisors normal axial inclination	51
Skeletal Class I	47
Average Frankfort–mandibular angle	36

Acknowledgements.—I would like to thank the other members of our team, Mr. P. M. C. James, Mr. D. A. Plint, and Mrs. A. D. Valentine, for all their hard work in collecting this material, and those in charge of the various schools we visited for their hospitality and general help, and the Directors of Messrs. Hedley & Sons for their very generous grant which made this research possible.

I would also like to thank Mr. J. H. Hovell for his helpful suggestions; Mrs. MacKenzie for her radiograph tracings and help in assessing the degree of my clinical accuracy; Mr.

Ready and Miss Sheila Bates of the Records Department, The Hospital for Sick Children, Great Ormond Street, who punched the Powers-Samas cards for me and extracted all this material; Mr. J. Shilland, of the Photographic Department of the Royal Dental Hospital, for the illustrations; and last, but not least, my secretary, Miss B. M. Horton, for working out the percentages, making up all the graphs, and generally helping me with this paper.

Mr. G. C. Dickson, in thanking the President on behalf of all present, said that it was the custom of the Society not to invite discussion of the Presidential Address unless that was the specific wish of the President. The customary discussion was replaced by a vote of thanks.

He had been told that there were two reasons for this: first, it gave the President the only opportunity that he was likely to have of making outrageous statements unchallenged; second, it absolved the proposer of the vote of thanks from the necessity to remain awake during the delivery of the paper. He was certain that neither of these conditions applied tonight, though Mr. Walther had slipped in one or two remarks that might have been torn apart by the wolves if opportunity had offered! He was himself looking forward to getting Mr. Walther on his own and asking him a few questions.

A paper of such standing demanded from its author a great deal of work. For the benefit of those who did not already know it, he would mention that the President was Reader in Orthodontics at the Royal Dental Hospital and the Hospital for Sick Children at Great Ormond Street. He was also Secretary of the European Orthodontists Society, which was to meet in Belfast in July. Despite all these interests he had found time not only to collect the informative statistics with which they had been presented, but to settle down and work them out.

He would like to thank him most heartily, on behalf of everyone present, for his extremely interesting address, and to wish him well in his Presidency during 1960.

ABSTRACTS FROM OTHER JOURNALS

The Tragedy of the Traumatized Anterior Tooth

Nothing should stand in the way of the dentist in an attempt to save a fractured maxillary anterior tooth. Every effort should be made to keep the pulp alive. It is to be remembered, however, that the pulp has as its primary function the formation of the tooth. When this function is complete the pulp gradually gives way to secondary dentine. It is the periodontal membrane which determines the life of a tooth. If this structure is maintained in a healthy condition when the pulp canal is properly filled no danger need arise from the retention of such a tooth.

When a child attends with a tooth which has just been evulsed from its socket, wrap the tooth in saline gauze and embed the whole in plaster. Leave the crown and 4 mm. of the apex free. Open into the pulp chamber via the crown, remove the pulp, enlarge the canal, and cut off 2 mm. from the apex. Syringe the canal with alternate solutions of 4 per cent sodium hypochlorite and 3 per cent hydrogen peroxide. Dry and drive home a silver point. Cut off any extruding point from the apex and polish. The silver point will tend to strengthen the weakened crown and also serve as a stabilizing implant when the root begins to resorb. Clean out the tooth socket under local anæsthesia, and because the root has been shortened by 2 mm. it should seat easily when replaced in the socket. Suture the soft tissues if necessary and make a removable splint with retaining wires over the incisal edge of the tooth. Until the splint is made, wire ligatures may be used to stabilize the tooth if necessary.

Anyone having to deal with children should be informed that a visit to the dentist is the first consideration whenever a child suffers a blow in the mouth. When in such a case a tooth is involved and fractured, place a local anæsthetic in the region and take an X-ray. If on this evidence the tooth is able to be saved, decide whether or not the pulp can be kept vital, if not extirpate immediately. If it can be saved, but is exposed, perform pulpotomy immediately, and place the final restoration to guard against marginal leakage. In the case of pulpectomy, strict asepsis may not be necessary, for the treatment is first aid and an analogy can be made with the surgeon dealing with a road accident who cannot work under aseptic conditions. Traumatized teeth with exposed tubules, except in very slight cases, require some protection. It is a great mistake to use a

full coverage crown because the pulp then loses its normal thermal stimulus. When the time comes to place a jacket crown one is dismayed to find in a late teenage patient a tooth with the pulp of a young child, and thus insufficient dentine for a satisfactory jacket crown preparation. A better plan is to use an open-faced crown, and in this way the tooth receives stimuli and it can be tested for vitality.—HARE, G. C. (1959), *J. Canad. dent. Ass.*, **25**, 674.

Periodontosis, associated with Gingival Lesions, in a Child

An 11-year-old girl presented with painful ulcers in the mouth of one week's duration, and a past history of similar ulceration at irregular intervals during the preceding two years. Each ulcer lasted about one week before healing. Nine discrete lesions were found along the gingival margins. They were bright red in colour and sharply defined. The surface was slightly raised, there was no blanching on pressure, and no pain or tenderness. The incisor teeth were freely mobile and the maxillary central incisors had drifted labially. Pocket formation extending almost the entire length of the anterior buccal roots of the maxillary first premolars was present. Other teeth showed no pocket formation and no loosening.

Histological examination of two typical lesions showed vascular connective tissue with heavy chronic inflammation and ulceration, and part of the epithelium was without superficial layers. Histologically the appearance was of a capillary hæmangioma.

A tentative diagnosis of multiple oral hæmangioma, causing bone resorption, was made.—CAWSON, R. A. (1959), *J. Periodont.*, **30**, 112.

Reaction of the Human Pulp to Cavity Preparation

Eight different operative grinding techniques were employed on a total of 450 non-carious vital teeth that were to be extracted for prosthetic or periodontal reasons. Class V buccal cavities were prepared under local anæsthesia and were filled with zinc oxide and eugenol. The teeth were extracted at periods ranging from 1 hour to 132 days.

The grinding techniques were varied in three ways, speed of instrument, type of instrument, and type of coolant. Speeds of 6000, 20,000, 50,000, 150,000, and 200,000 r.p.m. were used. The cavities were cut with diamond stones and carbide burs. The coolant was water, air, air/water, or none.

The resulting condition of the pulp was assessed by noting any "burn" lesions, whether lesions were confined to the cut tubules or not, the presence of secondary dentine, cellular displacement or exudate, and the appearance of abscess formation.

The results showed that, with the instruments tested, speeds of 50,000 r.p.m. and over appeared to cause less trauma than techniques with speeds of 6000 and 20,000 r.p.m. The value of coolants was shown and this was more significant at the higher speeds. In the absence of coolant intermittent grinding was of no benefit.—STANLEY, H. R., jun., and SWERDLOW, H. (1959), *J. Amer. dent. Ass.*, **58**, 49.

Repair of the Dento-gingival Junction following Surgical Intervention

Ten young adult mongrel dogs with full permanent dentitions were used in an experiment to study repair at the dento-gingival junction following surgical procedures.

Ten-millimetre pockets were produced by reflection of surgical flaps and osteo-ectomy, notches being made in the crown and also in the root at the lowest point of demarcation. A pack of zinc-oxide and eugenol was placed in the space created, and the wound sutured. The pack was allowed to remain for three weeks, after which it was removed and clinical measurements made. Animals were sacrificed at intervals of 23, 36, 41, 51, 59, 76, 158, 160, 308, and 331 days respectively, after which histological examination of the operative areas was performed.

It was found that new attachment of connective tissue averaged 1·50 mm., and new attachment of epithelium averaged 1·75 mm. These attachments occurred at a point in the apical third of the distance between the two

notches. The depth of the remaining pocket was reduced by atrophy of the soft-tissue flap and after the initial recession the depth remained more or less constant. No progressive coronal shift of the connective tissue or epithelial attachment ever occurred.—MARFINO, N. R., ORBAN, B. J., and WENTZ, F. M. (1959), *J. Periodont.*, **30**, 180.

Contact Stomatitis

Five months after an unsatisfactory but well-worn acrylic upper denture was replaced with a new one in the same material the patient returned for treatment of a sore mouth. Examination showed that the entire denture-bearing area of the maxilla was inflamed, as were the labial and buccal sulci and the inner surfaces of the cheeks and lips where the denture made contact. There was a mucinous exudate associated with the inflammation. The denture was faultless as regards stability and occlusion. Hot mouth-washes of salt, hydrogen peroxide, and Pickerill's liquor potassii and carbolic failed to relieve the symptoms. A patch test was carried out in the form of a small amount of acrylic dough strapped to the upper arm for 48 hours. When it was removed there was little reaction to be seen, but 3 days later there appeared a marked inflammation in the area and it was sharply defined to the shape of the dough. While the denture was being replaced in vulcanite and with porcelain teeth, a 1 per cent hydrocortisone acetate cream was applied to the site of the inflammation. This failed to eradicate the inflammation completely, although the mucinous exudate was decreased. Ten days after the insertion of the vulcanite denture the tissues had almost returned to normal. It was presumed that the patient had been suffering from a delayed contact allergy to acrylic resin.—HANSEN, M. C. G. (1960), *J. dent. Ass. S. Afr.*, **15**, 96.

Presence of Acetylcholinesterase in Human Gingiva

Fifty samples of fresh gingival biopsy tissue were obtained and examined for the presence of acetylcholinesterase. (It is not stated whether the tissue was healthy or diseased.)

It was found that specific ChE is present in the connective tissue papillæ underlying human gingival epithelium and non-specific ChE is present in concentrated amounts in blood-vessels located throughout the papillæ and reticular layers of the lamina propria.—AVERY, J. K., and RAPP, R. (1959), *J. Periodont.*, **30**, 152.

LETTERS TO THE EDITOR

July 10, 1960

Dear Sir,

Whilst I agree with Dr. Senior that the submission of valueless radiographs for payment cannot be too strongly deplored, the value of six-monthly bite-wing radiographs in the maintenance of dental fitness in a large practice is considerable.

Incidentally, if of good quality, bite-wing radiographs provide the best evidence of the necessity of work prescribed and, if repeated regularly, provide, both to the practitioner and to the authorities, decisive evidence of the quality of the work completed.

Yours sincerely,
D. L. ALBERT

Granville House,
Station Road,
Redhill, Surrey.

July 5, 1960

Dear Sir,

From the contents of your Editorial of the May issue of the PRACTITIONER it would appear that you are unaware that there is an air-turbine which virtually eliminates all the "hazards" to which you refer. It is of American manufacture, and for some unknown reason not advertised in this country. However, after some 15 months of trouble-free use I can thoroughly recommend it.

It has the following advantages over most of the turbines generally in current use in this country:—

1. Spent air exhausted through handpiece handle;
2. Cutting instruments held in split collet chuck giving true central running and allowing different lengths of bur to be used;
3. *No* oil mist lubrication (a very simple greasing procedure).
4. Adjustable water-spray for different lengths of bur;
5. Uses existing engine foot control;
6. Lower noise level than most.

I must add that I have absolutely no connexion with either the makers or agent for this particular turbine and for this reason only omit the name of it here. However, should you be interested I will be only too pleased to give it you on request.

Yours faithfully,
P. GASKELL

3 *Silver Street,*
Cambridge.

INDEX

VOLUME X, Nos. 1—12 (SEPTEMBER, 1959—AUGUST, 1960)

PAGE

A

ABNORMALITIES, dental, taurodontism associated with - - - - - - - 202
— of facial skeleton, surgical treatment of - - 170
— occlusal, relationship between speech, tongue behaviour, and - - - - - **11**
Abscess, apical, conservation of post crowned incisors with - - - - - 54
Abstracts 5, 13, 15, 18, 35, 38, 42, 52, 58, 86, 93, 121, 122, 128, 136, 152, 157, 167, 168, 180, 186, 195, 205, 209, 212, 221, 229, 233, 234, 245, 256, **33, 46, 58, 69, 82, 92, 94, 97, 99, 114, 122, 130, 154**
Adams cribs, fracture of - - - - - 224
Adrenaline—its role in local anæsthetic solutions for dentistry - - - - - 2
Aglossia, partial, congenital - - - **83**
Amalgam, cervical, its restoration and failure - 158
— relationship of, to cavity wall, - - - 76
American Dental Society of Europe: Eliminating the guesswork, uncertainty, and worry in the mixing of dental cements, 39; Natural tooth placement and base contour in full denture construction, 6
Anæsthesia, local, of mandibular molar teeth - 36
— premedication and - - - - - 100
Anæsthetic solutions, local, adrenaline in - - 2
Analysis, cephalometric, centres of gravity in - 107
— of the commonest causes of full denture failure - 61
ANGELMAN, J.: Clasp stabilizer for removable appliances - - - - - - 116
— — The lateral arm in removable appliance therapy - - - - - - **95**
Angle Class II, division 1 malocclusion, complicated by gross overcrowding - - - **29**
— of mouth in Bell's palsy, device to support - 14
Anteroposterior expansion of mandibular arch, modified 0·7 mm. lingual arch for - - **88**
Apical abscess, conservation of post crowned incisors with - - - - - 54
Appliance, removable, clasp stabilizer for - - 116
— screw and hinge - - - - 161
— technique, aids to - - - - **93**
— therapy, removable, lateral arm in - - **95**

PAGE

Arch, Johnson twin wire, uses and modifications of **34**
— mandibular, modified 0·7 mm. lingual arch for anteroposterior expansion of - - **88**
ATHERTON, J. D.: A simple spring for buccal movement of palatally displaced teeth - 106

B

BAIRD, W. J.: Diabetes and periodontal disease - 137
BARKER, B. C. W.: The conservation of post crowned incisors with apical abscess - 54
Base contour in full denture construction, natural tooth placement and - - - - 6
BATES, J. F.: Full denture construction in relation to general practice - - - - - 26
BEAGRIE, G. S.: Pre-clinical teaching—the phantom head - - - - - - 246
Bell's palsy, device to support angle of mouth in - 14
BERRY, D. C.: The constancy of the rest position of the mandible - - - - - 129
BIRD, PETER D.: The radiographic location of unerupted maxillary teeth with the vertex occlusal view - - - - - 181
BLACKMAN, S.: Pan-oral radiology - - - 270
BLAKE, J. C., and TROTT, J. R.: Acute streptococcal gingivitis - - - - - - 43
Blood diseases, oral manifestations of - - 248
BLYTH, P.: The relationship between speech, tongue behaviour, and occlusal abnormalities - **11**
Book Reviews (*see* Reviews)
British Society of Dental Radiology: Dental radiology in the National Health Service, 222; Radiographic location of unerupted maxillary teeth with the vertex occlusal view, 181
British Society of Periodontology, Proceedings of: Acute streptococcal gingivitis, 43; Deepening the buccal sulcus as an adjunct to gingivectomy, 206; Diagnosis, 87; Oral manifestations of blood diseases, 248; Prevention of periodontal diseases, III. Fibrous foods, 45; Scandinavian symposium, 168; Silicious deposits in the oral soft tissues of industrial workers, 64; The surgical treatment of the infrabony pocket, 225; The use of rotary diamond instruments in gingivoplasty, 153

PAGE

British Society for the Study of Orthodontics, Transactions of: Aids to appliance technique, **93**; Brains trust, **70**; Cinéradiographic studies of tongue behaviour, **135**; A Class III case treated with simple apparatus, **66**; A Class III case with overclosure—A clinical and cephalometric study, **59**; Congenital partial aglossia, **83**; Contrasting treatment in two brothers, **123**; Early development of the deciduous dentition, **100**; Further report on a case demonstrating bodily movement of upper incisor teeth, **131**; Genetics and clinical research, **115**; Impacted second mandibular molars, **23**; An investigation into the influence of the soft tissues on tooth position, **89**; The lateral arm in removable appliance therapy, **95**; A modified electrolyte for polishing stainless steel, **98**; A modified Jackson spring, **98**; Modified 0·7 mm. lingual arch for anteroposterior expansion of the mandibular arch, **88**; The orthodontic treatment of a set of uniovular quadruplets, **73**; Rehabilitation of the child with cleft lip and palate, **47**; The relationship between speech, tongue behaviour, and occlusal abnormalities, **11**; Some of the causes and effects of malocclusion, **139**; Treatment of a case of Angle Class II, division 1 malocclusion, complicated by gross overcrowding, **29**; Uses and modifications of the Johnson twin wire arch, **34**

BROADWAY, R. T.: Treatment of a case of Angle Class II, division 1 malocclusion, complicated by gross overcrowding - - **29**

Brothers, contrasting treatment in two - - **123**

Buccal movement of palatally displaced teeth, simple spring for - - - - 106

— sulcus, deepening, as an adjunct to gingivectomy - - - - - 206

BURKE, P. H.: Contrasting treatment in two brothers - - - - - **123**

C

CAMPBELL, J. MENZIES: Nicolas Dubois de Chémant 133

Causes and effects of malocclusion - - - **139**

Cavity wall, relationship of amalgam to - - 76

Cellulitis, unusual, of floor of mouth - - 94

Cements, dental, mixing of - - - - 39

Cephalometric analysis, centres of gravity in - 107

Cervical amalgam restoration and its failure - 158

Chémant, Nicolas Dubois de - - - 133

Child with cleft lip and palate, rehabilitation of - **47**

Cinéradiographic studies of tongue behaviour - **135**

CLARKE, J., and HOLMES, G.: Local anæsthesia of the mandibular molar teeth—a new technique - - - - - 36

Clasp stabilizer for removable appliances - - 116

Class III case treated with simple apparatus - **66**

— — — with overclosure—a clinical and cephalometric study - - - - **59**

Cleft lip and palate, rehabilitation of child with - **47**

Clinical research, genetics and - - - **115**

Congenital epulis of the newborn - - - 11

— malformations of mouth and jaws - - 236

Congenital partial aglossia - - - - - **83**

Conservation of post crowned incisors with apical abscess - - - - - - 54

Constancy of the rest position of the mandible - 129

Contrasting treatment in two brothers - - **123**

CRAIG, W. S.: *see* READ, T. TALMAGE, jt. auth.

Cribs, Adams, fracture of - - - - 224

D

DECIDUOUS dentition, early development of - **100**

Deepening the buccal sulcus as an adjunct to gingivectomy - - - - - - 206

Dental abnormalities, taurodontism associated with 202

— cements, mixing of - - - - - 39

— origin, facial pain of - - - - 59

— **Radiology, British Society of** (*see* British Society of Dental Radiology)

— — in the National Health Service - - 222

— **Society, American, of Europe** (*see* American Dental Society of Europe)

— turbine drill, effect of noise of - - - 148

Dentinogenesis imperfecta, hereditary, rehabilitation for - - - - - - 16

Dentition, deciduous, early development of - **100**

Denture construction, full, natural tooth placement and base contour in - - - - - 6

— — — in relation to general practice - - 26

— failure, full, causes of - - - - 61

— impressions, full, 'stop' technique for - - 188

Deposits, silicious, in oral soft tissues of industrial workers - - - - - - 64

Development, early, of deciduous dentition - **100**

Diabetes and periodontal disease - - - 137

Diagnosis - - - - - - - 87

Diamond instruments, rotary, in gingivoplasty - 153

Difficult extractions, pre-extraction radiographs in 196

Disease, periodontal, diabetes and - - - 137

DIXON, D. A.: An investigation into the influence of the soft tissues on tooth position - - **89**

Drill, dental turbine, effect of noise of - - 148

DRUMMOND-JACKSON, S. L.: Premedication and anæsthesia - - - - - - 100

E

Early development of deciduous dentition - **100**

ECCLES, J. D.: Studies on the development of the periodontal membrane—the principal fibres of the molar teeth - - - - - 31

Editorial 1, 25, 53, 75, 99, 123, 147, 169, 187, 213, 235, 257

Effect of noise made by dental turbine drill - 148

Electrolyte, modified, for polishing stainless steel - **98**

Eliminating the guesswork, uncertainty, and worry in the mixing of dental cements - - 39

Epulis, congenital, of newborn - - - 11

Extractions, difficult, pre-extraction radiographs in 196

F

FACIAL pain of unusual dental origin - - 59

— skeleton, surgical treatment of abnormalities of 170

Fibroma of the mandible - - - - 114

PAGE

Fibrous foods in prevention of periodontal diseases 45
FINDLAY, IAN A.: A head-rest for oral surgery - 124
Fit of gold inlays, laboratory factors affecting - 214
Floor of mouth, unusual cellulitis of - - 94
Foods, fibrous, in prevention of periodontal diseases 45
FOX, E. C., and MARSLAND, E. A.: Silicious deposits in the oral soft tissues of industrial workers 64
Fracture of Adams cribs - - - - - 224
Free-end saddle - - - - - 267
Full denture construction, natural tooth placement and base contour in - - - - 6
— — — in relation to general practice - - 26
— — failure, commonest causes of - - 61
— — impressions, "stop" technique for - - 188

G

GARDINER, J. H.: Congenital partial aglossia - **83**
GEDDES, I. C.: *see* MUMFORD, J. M., jt. auth.
General practice, full denture construction in relation to - - - - - 26
Genetics and clinical research - - - **115**
Gingivectomy, deepening buccal sulcus as an adjunct to - - - - 206
Gingivitis, acute streptococcal - - - 43
Gingivoplasty, use of rotary diamond instruments in 153
GLASS, DENIS: Rehabilitation of the child with cleft lip and palate - - - - **47**
Gold inlays, laboratory factors affecting fit of - 214
GOOSE, D. H.: Oral hygiene campaign in Wellingborough - - - - - 258
GOULD, D. G.: A Class III case treated with simple apparatus - - - - - **66**
— — Modified 0·7 mm. lingual arch for anteroposterior expansion of the mandibular arch **88**
Gravity, centres of, in cephalometric analysis - 107

H

HALDEN, J. R.: Further report on a case demonstrating bodily movement of upper incisor teeth - - - - - **131**
HATT, S. D.: The relationship of amalgam to the cavity wall - - - - - 76
Head, phantom, in pre-clinical teaching - - 246
Head-rest for oral surgery - - - - 124
HEATH, J., Sen.: Fracture of Adams cribs - - 224
Hereditary dentinogenesis imperfecta, rehabilitation for dentition affected by - - - 16
HESLOP, IAN H.: Facial pain of unusual dental origin - - - - - 59
— — Fibroma of the mandible - - - 114
HINDLE, M. O.: An unusual cellulitis of the floor of the mouth - - - - 94
Hinge and screw appliance - - - - 161
HOLMES, G.: *see* CLARKE, J., jt. auth.
HOVELL, J. H.: The surgical treatment of some of the less common abnormalities of the facial skeleton - - - - - 170
HOWE, GEOFFREY L.: The use of pre-extraction radiographs in the management of difficult extractions - - - - - 196

PAGE

I

IMPRESSIONS, full denture, "stop" technique for - 188
Incisor, post crowned, with apical abscess, conservation of - - - - - - 54
— teeth, upper, bodily movement of - - **131**
Industrial workers, silicious deposits in oral soft tissues of - - - - - 64
Influence of the soft tissues on tooth position - **89**
Infrabony pocket, surgical treatment of - - 225
Inlays, gold, laboratory factors affecting fit of - 214
— porcelain, new approach to - - - 263
Investigation into the influence of the soft tissues on tooth position - - - - **89**

J

JACKSON, MRS. S. J.: Aids to appliance technique - **93**
— spring, modified - - - - - **98**
Jaws, congenital malformations of mouth and - 236
JOHNSON, J. S.: The uses of centres of gravity in cephalometric analysis: a preliminary report 107
— twin wire arch, uses and modifications of - **34**
JOSEPH, E. K.: A new approach to porcelain inlays 263

K

KALMUS, H.: Genetics and clinical research - **115**
KANTOROWICZ, G. F.: The cervical amalgam restoration and its failure - - - 158
KNOWLES, C. C.: A simple device to support the angle of the mouth in Bell's palsy - - 14

L

LABORATORY factors affecting the fit of gold inlays 214
Lateral arm in removable appliance therapy - **95**
LAWSON, W. A.: An analysis of the commonest causes of full denture failure - - 61
LEIGHTON, B. C.: Early development of the deciduous dentition - - - - **100**
Letters to the Editor 24, 52, 73, 97, 122, 132, 166, 184, 278
Lingual arch, modified 0·7 mm., for anteroposterior expansion of mandibular arch - **88**
Local anæsthesia of the mandibular molar teeth—a new technique - - - - 36
— anæsthetic solutions, adrenaline in - - 2
Location, radiographic, of unerupted maxillary teeth with the vertex occlusal view - - 181

M

MCGEE, G. F.: Natural tooth placement and base contour in full denture construction - 6
MACGREGOR, A. R.: The free-end saddle - - 267
Malformations, congenital, of mouth and jaws - 236
Malocclusion, Angle Class II, division 1, complicated by gross overcrowding - - - **29**
— causes and effects of - - - - **139**

PAGE

Mandible, constancy of rest position of - - 129
— fibroma of - - - - - 114
Mandibular arch, modified 0·7 mm. lingual arch for anteroposterior expansion of - - **88**
— molar, impacted second - - - **23**
— — teeth, local anæsthesia of - - - 36
MARSLAND, E. A.: *see* FOX, E. C., jt. auth.
MARTIN, J. H.: A modified electrolyte for polishing stainless steel - - - - **98**
Maxillary teeth, unerupted, radiographic location of, with vertex occlusal view - - - 181
MILLS, J. R. E.: Uses and modifications of the Johnson twin wire arch - - - **34**
Ministry of Health, set of posters for dental education of public - - - - 46
Mixing of dental cements - - - - 39
Modern Medicine: Diabetes mellitus, 20; Fluothane, 50; Modern steroid therapy, 50; Sleep for your joints' sake, 20
Modified electrolyte for polishing stainless steel - **98**
— Jackson spring - - - - - **98**
— 0·7 mm. lingual arch for anteroposterior expansion of the mandibular arch - - **88**
Molar, mandibular, impacted second - - **23**
— teeth, mandibular, local anæsthesia of - - 36
— — principal fibres of—development of periodontal membrane - - - - 31
Mouth, angle of, device to support, in Bell's palsy - 14
— and jaws, congenital malformations of - - 236
— unusual cellulitis of floor of - - - 94
Movement, bodily, of upper incisor teeth - - **131**
MUMFORD, J. M., and GEDDES, I. C.: Adrenaline—its role in local anæsthetic solutions for dentistry - - - - - 2
MUNNS, D.: Impacted second mandibular molars - - - - - **23**

N

NATIONAL Health Service, dental radiology in - 222
Natural tooth placement and base contour in full denture construction - - - 6
New approach to porcelain inlays - - - 263
Newborn, congenital epulis of - - - 11
New Materials and Appliances: Adrenoxyl, 98; Antoin tablets, 185; Ascoxal, 98; Aspirating syringe, 74; Ellis headband magnifier, 185; Faster X-ray films, 74; Hostacain "special", 74; Ligature cutting pliers, 19; Multi-fired porcelain anterior teeth, 164; Nebrinal tablets, 185; New drugs, 74; New scalpel design, 98; New toothbrush design, 19; Nyman copper ring flanging device, 74; Opticular, 164; Paper towels and dispensing cabinets, 19; Revised casting technique for pallacast, 74; Silicate cement, 164; Split-beak forceps, 98; Strepsils lozenges, 164; Svedopter, Swebond, Dropsin, 98; Throsil lozenges, 164; Tungsten carbide instruments, 164; Ultrasonic cleaning equipment, 19; Xylotox oral, 185; Zactirin, 164; Zactirin tablets, 185
Nicolas Dubois de Chémant—A contribution to dental history - - - - 133
Noise of dental turbine drill, effect of - - 148

PAGE

O

OCCLUSAL abnormalities, speech, tongue behaviour, and - - - - - - - 11
Odonto-chirurgical Society of Scotland: Surgical treatment of abnormalities of facial skeleton 170
OLIVER, W. M.: The use of rotary diamond instruments in gingivoplasty - - - 153
Oral hygiene campaign in Wellingborough - - 253
— manifestations of blood diseases - - 248
— soft tissues of industrial workers, silicious deposits in - - - - - 64
— surgery, head-rest for - - - - 124
Orthodontic treatment of a set of uniovular quadruplets - - - - - **73**
Orthodontics, British Society for the Study of (*see* British Society for the Study of Orthodontics)
Overclosure, Class III case with - - - **59**
Overcrowding, gross, complicating Angle Class II, division 1 malocclusion - - - **29**

P

PAIN, facial, of unusual dental origin - - 59
Palate (cleft), rehabilitation of child with cleft lip and - - - - - - **47**
Pan-oral radiology - - - - - 270
PARKER, C. D.: A Class III case with overclosure—A clinical and cephalometric study - - **59**
Partial aglossia, congenital - - - - **83**
Periodontal disease, diabetes and - - - 137
— — prevention of, III. Fibrous foods - - 45
— membrane, development of—principal fibres of the molar teeth - - - - 31
Periodontology, British Society of (*see* British Society of Periodontology)
Phantom head in pre-clinical teaching - - 246
Polishing stainless steel, modified electrolyte for - **98**
Porcelain inlays, new approach to - - - 263
Post crowned incisors with apical abscess, conservation of - - - - - - 54
POUSTIE, J.: The screw and hinge appliance - 161
Pre-clinical teaching—the phantom head - - 246
Pre-extraction radiographs in management of difficult extractions - - - - 196
Premedication and anæsthesia - - - 100
Prevention of periodontal diseases, III. Fibrous foods - - - - - - 45

Q

QUADRUPLETS, uniovular, orthodontic treatment of a set of - - - - - - **73**

R

RADIOGRAPHIC location of unerupted maxillary teeth with the vertex occlusal view - - 181
Radiographs, pre-extraction, in management of difficult extractions - - - - 196
Radiology, dental, in National Health Service - 222
— pan-oral - - - - - - - 270

PAGE

RAMSAY, K. PAUL: Eliminating the guesswork, uncertainty, and worry in the mixing of dental cements - - - - 39
READ, T. TALMAGE, and CRAIG, W. S.: Congenital epulis of the newborn - - - 11
Rehabilitation of the child with cleft lip and palate **47**
— for a dentition affected by hereditary dentinogenesis imperfecta - - - - 16
Relationship of amalgam to the cavity wall - 76
— between speech, tongue behaviour, and occlusal abnormalities - - - - **11**
Removable appliance(s), clasp stabilizer for - 116
— — therapy, lateral arm in - - - **95**
Research, clinical, genetics and - - - **115**
Rest position of mandible, constancy of - - 129
Restoration, cervical amalgam, failure of - - 158
Reviews:—
Anatomy for students of dentistry (J. H. Scott and A. D. Dixon) - - - - 119
Archives of oral biology, Vol. 1, No. 1 - - 165
Bacteriology for students of dental surgery (R. B. Lucas and I. R. H. Kramer) - - 145
Clinical dental hygiene (ed. S. Peterson) - - 48
Conduction, infiltration and general anæsthesia in dentistry (M. Nevin, M. I. Nevin, and J. R. Burgoyne) - - - - - 23
Dental auxiliary personnel (ed. R. K. Stinaff) - 230
Dental-medical emergencies and complications (Ira J. Berlove) - - - - 23
Dental roentgenology (LeR. M. Ennis and H. M. Berry) - - - - - 232
The dentition of the growing child (C. F. A. Moorrees) - - - - - 118
Essentials of removable partial denture prosthesis (O. C. Applegate) - - - - 210
Fluoridation (P. R. N. Sutton) - - - 231
Fundamentals of general anæsthesia for students and practitioners of dentistry (J. Adriani) - 47
The future of orthodontics (ed. R. E. Moyers and P. Jay) - - - - - 274
Handbook of dental practice (ed. L. I. Grossman) 184
Handbook of orthodontics for the student and general practitioner (R. E. Moyers) - - - 71
High speed and ultra speed in dentistry (H. C. Kilpatrick) - - - - - 183
Hypnosis in general dental practice (T. W. Frost) 120
Introduction to dental anatomy (J. H. Scott and N. B. B. Symons) - - - - 72
An introduction to surgery for dental students (R. P. Jepson) - - - - 48
Laboratory manual of biological chemistry for students of dentistry (W. C. Hess and J. C. Muhler) - - - - - 166
The management of oral diseases (J. L. Bernier) - 146
The mouth. Its clinical appraisal (A. B. Riffle) - 97
Occlusal equilibration and temporomandibular joint dysfunction (N. A. Shore) - - 49
Oral histopathology (M. A. Rushton and B. E. D. Cook) - - - - - 22
Oral radiography (W. H. Johnson) - - 183
Partial dentures (J. Osborne and G. A. Lammie) 70
Partial dentures (M. G. Swenson and L. G. Terkla) 117
Pathologic physiology of oral disease (R. W. Tiecke, O. H. Stuteville, and J. C. Calandra) - 96
Practical oral surgery (H. B. Clarke, jun.) - - 211
Précis de stomatologie (M. Dechaume) - - 232
Prothèse dentaire squelettique (J. Rouot) - - 166

PAGE

Reviews (*cont.*):—
The resiliency of the edentulous alveolar ridges (T. Arstad) - - - - - 256
A synopsis of pharmacology (V. C. Sutherland) - 165
Techniques modernes d'utilisation des matériaux à empreintes en prothèse fixe (J. Poggioli) - 22
Textbook of biochemistry for students of dentistry (ed. J. C. Muhler) - - - - 72
Textbook of oral surgery (ed. G. O. Kruger) - 210
Traumatismes accidentels en stomatologie (P. Marroneaud, M. Peri, C. Crepy, and J. Lechard) - - - - - 255
Treatment planning in the practice of dentistry (H. M. Goldman and L. W. Burkett) - 146
Tumours of the oral region (ed. H. B. G. Robinson) 71
RITCHIE, J. C.: The orthodontic treatment of a set of uniovular quadruplets - - - **73**
ROBIN, IAN G.: Effect of noise made by the dental turbine drill - - - - - 148
Rotary diamond instruments in gingivoplasty - 153
ROUTLEDGE, R. T.: Congenital malformations of the mouth and jaws - - - - 236

S

SADDLE, free-end - - - - - - 267
Scotland, Odonto-chirurgical Society of (*see* Odonto-chirurgical Society of Scotland)
Screw and hinge appliance - - - - 161
Second mandibular molars, impacted - - **23**
SENIOR, W. G.: Dental radiology in the National Health Service - - - - 222
SHAW, J. GEOFFREY: Deepening the buccal sulcus as an adjunct to gingivectomy - - 206
Skeleton, facial, abnormalities of - - - 170
SLACK, G. L.: Prevention of periodontal diseases, III. Fibrous foods - - - - 45
Soft tissues, influence of, on tooth position - - **89**
Speech, tongue behaviour, and occlusal abnormalities - - - - - - **11**
SPOUGE, J. D.: The surgical treatment of the infrabony pocket - - - - 225
Spring, modified Jackson - - - - **98**
— simple, for buccal movement of palatally displaced teeth - - - - 106
Stabilizer, clasp, for removable appliances - - 116
STAFFORD, J. L.: Oral manifestations of blood diseases - - - - - 248
Stainless steel, modified electrolyte for polishing - **98**
"Stop" technique for full denture impressions - 188
STOY, P. J.: Taurodontism associated with other dental abnormalities - - - 202
Streptococcal gingivitis, acute - - - 43
Studies on the development of the periodontal membrane—the principal fibres of the molar teeth - - - - 31
Sulcus, buccal, deepening, as adjunct to gingivectomy - - - - - - 206
Surgery, oral, head-rest for - - - - 124
Surgical treatment of abnormalities of facial skeleton - - - - - 170
— — of infrabony pocket - - - - 225

T

TAURODONTISM associated with other dental abnormalities - - - - 202

PAGE

Teaching, pre-clinical—the phantom head - - 246
Teeth, mandibular molar, local anæsthesia of - 36
— palatally displaced, simple spring for buccal movement of - - - - - 106
— placement, natural, and base contour in full denture construction - - - 6
— position, influence of soft tissues on - - **89**
— upper incisor, bodily movement of - - **131**
Tongue behaviour, cinéradiographic studies of - **135**
— — speech, and occlusal abnormalities - - **11**
Treatment of a case of Angle Class II, division 1 malocclusion, complicated by gross overcrowding - - - - - **29**
— contrasting, in two brothers - - - **123**
TROTT, J. R.: *see* BLAKE, J. C., jt. auth.
TULLEY, W. J.: Cinéradiographic studies of tongue behaviour - - - - - **135**
Turbine drill, dental effect of noise of - - 148
TURRELL, A. J. W.: A "stop" technique for full denture impressions - - - - 188

U

UNERUPTED maxillary teeth, radiographic location of, with vertex occlusal view - - 181
Uniovular quadruplets, orthodontic treatment of a set of - - - - - **73**
Unusual cellulitis of the floor of the mouth - 94
Uses and modifications of the Johnson twin wire arch - - - - - - - 34

V

VERTEX occlusal view, radiographic location of unerupted maxillary teeth with - - 181

W

WADE, A. BRYAN: Diagnosis - - - 87
WALTHER, D. P.: Some of the causes and effects of malocclusion - - - - **139**
WARD, N. LIVINGSTONE: Rehabilitation for a dentition affected by hereditary dentinogenesis imperfecta - - - - 16
Wellingborough, oral hygiene campaign in - 258
WILLIAMS, ROBERT W.: Laboratory factors affecting the fit of gold inlays - - - 214
Wire arch, Johnson twin, uses and modifications of **34**
Workers, industrial, silicious deposits in oral soft tissues of - - - - - 64

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VOL. X, NO. 12 AUGUST, 1960

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CONTENTS

Editorial: Extending the Boundaries of Dental Research

An Oral Hygiene Campaign in Wellingborough: D. H. Goose, B.Sc., B.D.S.

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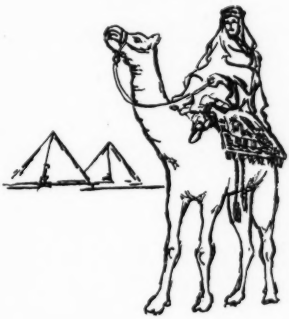

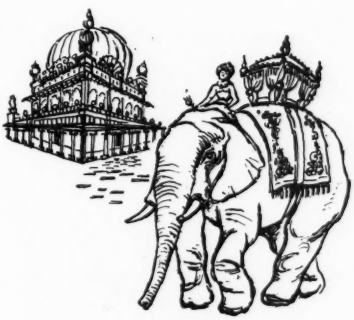

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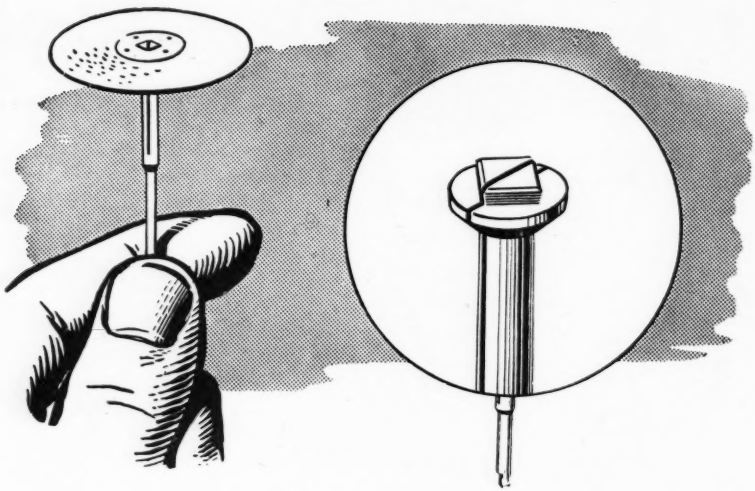

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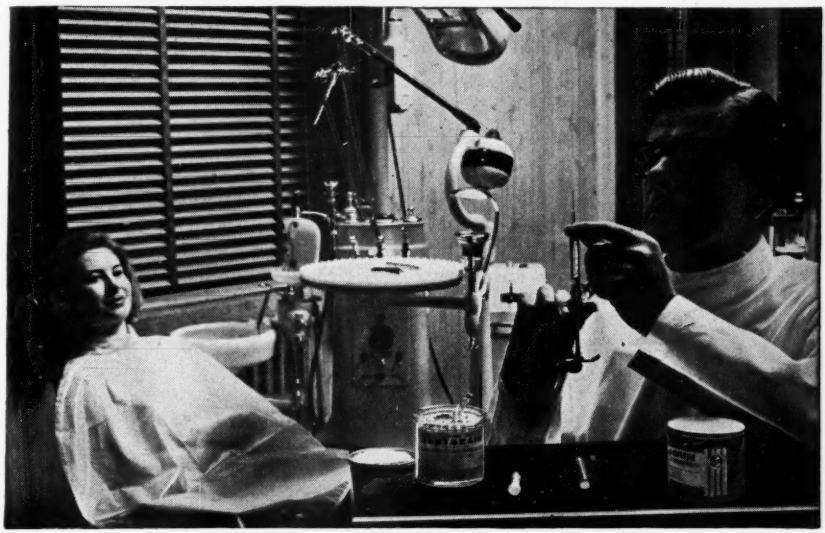

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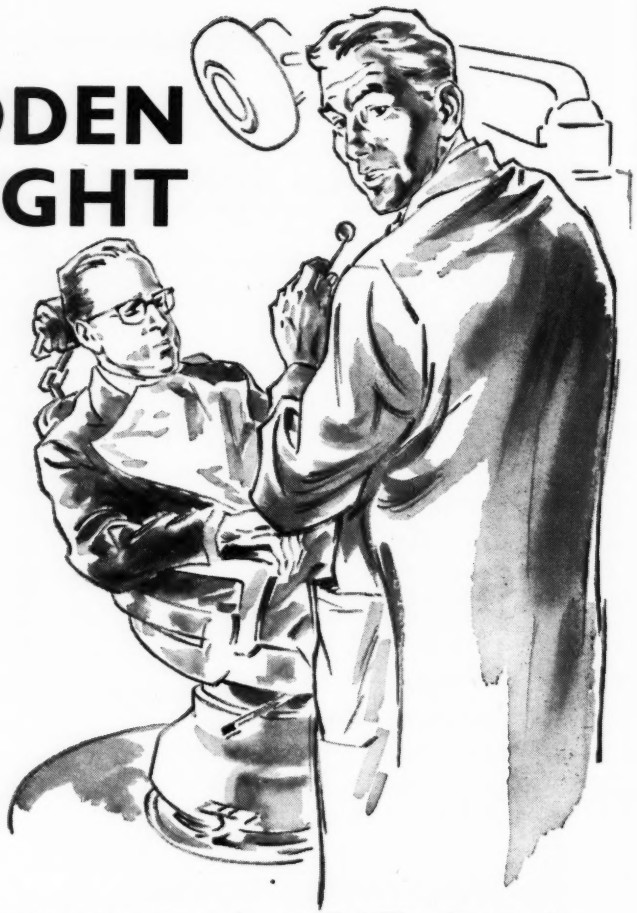

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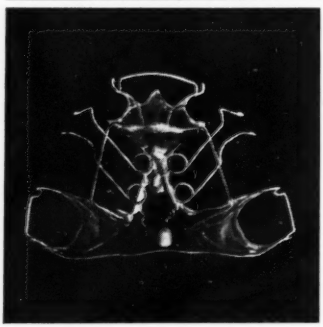

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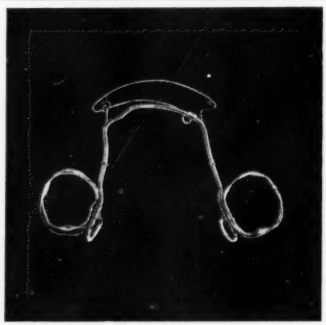

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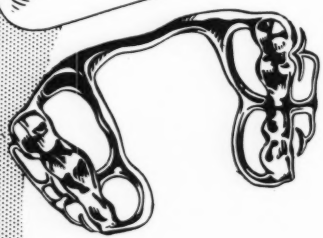

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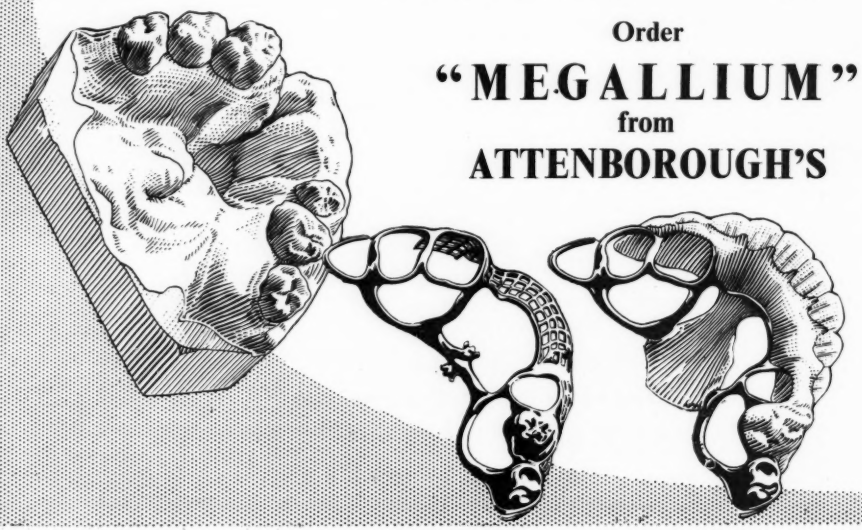

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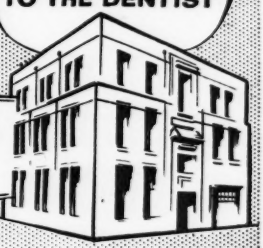

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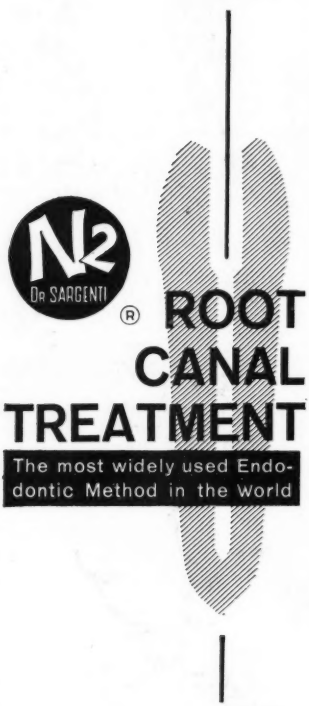

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